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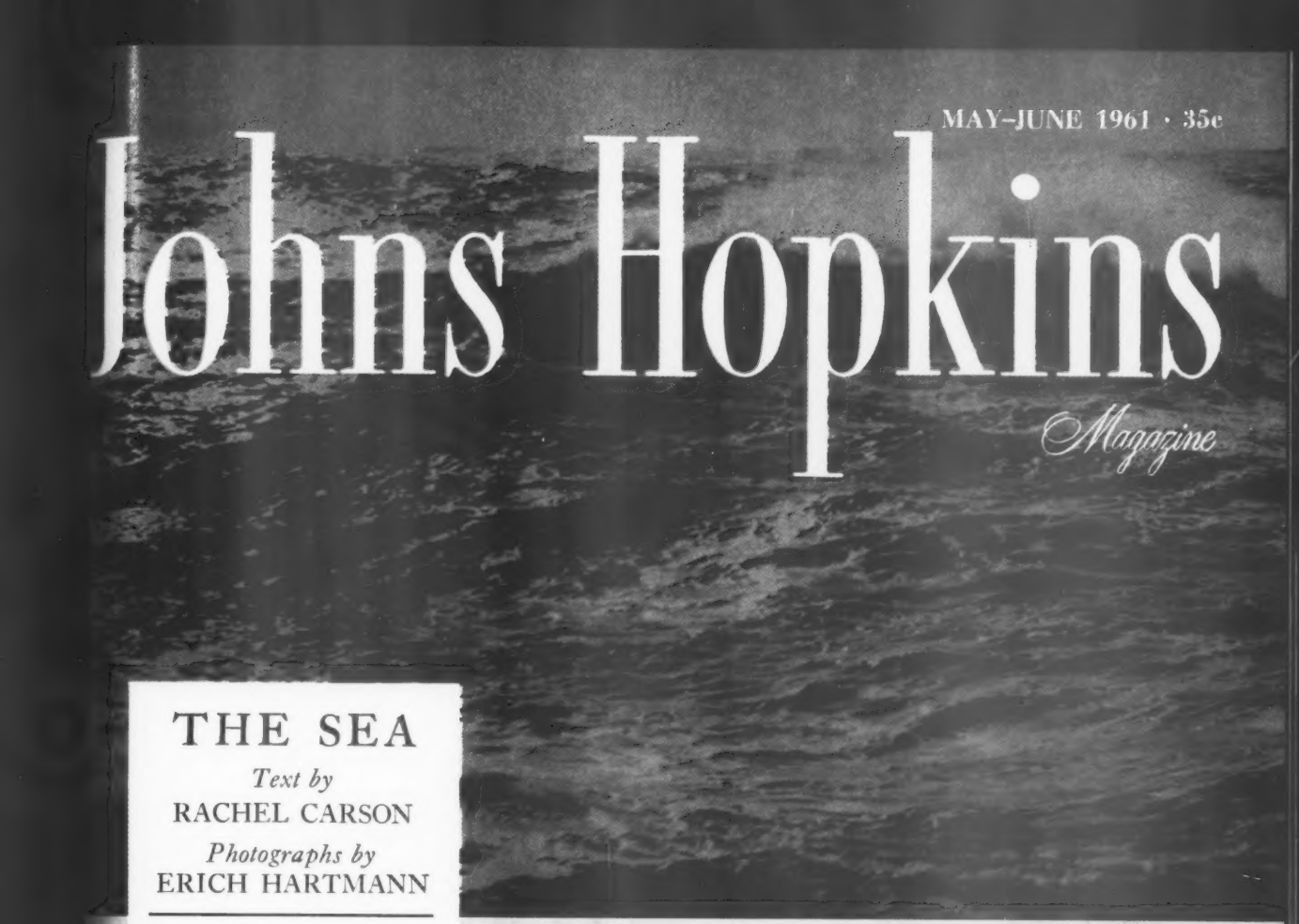
Johns Hopkins Magazine



THE SEA

Text by
RACHEL CARSON
Photographs by
ERICH HARTMANN

THE PROMISE OF THE SEA

WILLIAM D. McELROY

THE EARTH

Text by
GEORGE F. CARTER

RESOURCES FOR THE FUTURE

HARRISON BROWN

Steps Forward

A Sampling of Research in Progress at Johns Hopkins

"Beginnings are apt to be shadowy, and so it is wi be

ERICH HARTMANN, MAGNUM

is w beginnings of that great mother of life, the sea."

"The first living things crept from the sea into a wo sil

WILLIAM C. HAMILTON

wor silent stone, eroding and washing back to the seas."

A MONTH and a half ago, the Russians announced that they had rocketed a man into space and returned him safely to earth. This, without doubt, was a magnificent achievement, a splendid technological feat. Yet the accomplishment itself is not quite so remarkable as the fact that it occurred in an age when millions of people are ill-fed and ill-clothed, have never seen a plow or a window pane or an automobile, cannot read or write, and have not the vaguest notion of what a rocket is. And so, with this latest human triumph, the true time zones of the world span millennia, and at this very minute, the lives of men reach from the stone age to the space age.

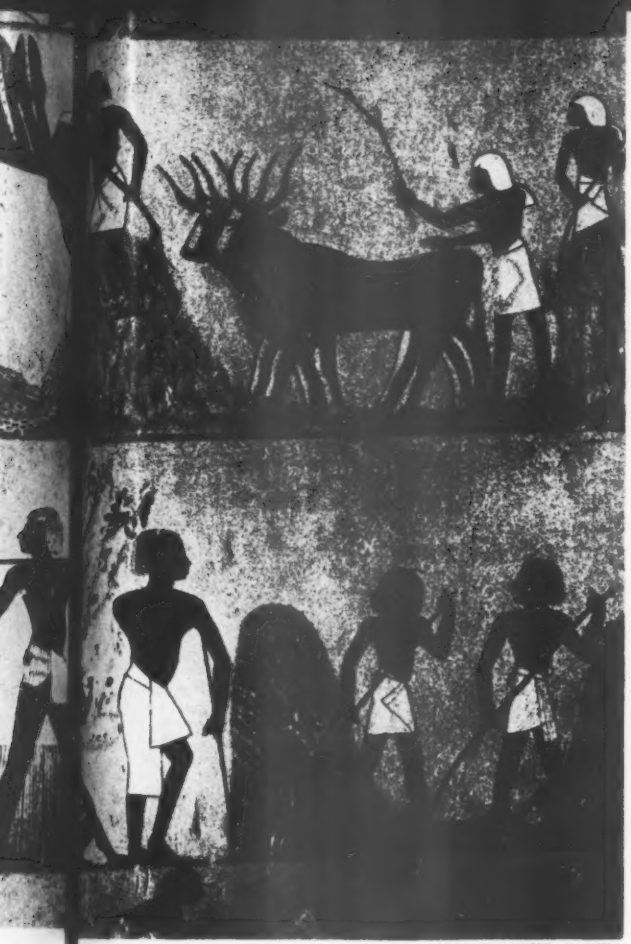
In its simplest terms, man's venture into space is an effort to overcome the limitations of his physical world. This is what he has always tried to do; this is truly the story of his life.

Man's use of the earth, from the time he left the trees to the day he crossed the threshold of space, has been both glorious and tragic. He has turned barren wasteland into fertile gardens, has erected grand civilizations, has harnessed the rivers, and mined the earth. But he has also plundered his rich natural endowment, befouling it, leaving it dead and useless. Prompted by greed, shackled by ignorance, man has exploited his land and his fellow men, creating in the wake of his pillage, poverty and tragedy.

Probably never before have we been so self conscious about use and misuse of our natural endowment. Goaded by the fear that the sources of our very survival are endangered, by the awesome reality of an uncontrolled population growth, by the awareness that three-fourths of the world's people are becoming restless and discontent with their miserable lot, we have turned increasing attention to our physical environment.

In this issue of the *Magazine*, four scholars look briefly at man and his world. They provide more questions than answers: Can this planet support an expanding industrial civilization? Will the seas yield unlimited food and fresh water? Why do some men live in splendor while others live in squalor? What of the future?

Such questions are indicative of the scope of the



ELLIOTT ERWITT, MAGNUM

problem. They will not be answered easily, for they are inextricably entwined with social, political, and economical forces. Since the debate began, there has been vigorous disagreement, and it continues—even, to some degree, in the pages that follow. For example, Rachel Carson writing elsewhere, says "To dispose first [of atomic waste] and investigate later is an invitation to disaster, for once radioactive elements have been deposited at sea, they are irretrievable." William D. McElroy, though concerned, does not feel the situation to be so alarming. Harrison Brown sees danger in an uncontrolled and exploding world population which, a few weeks ago, passed the three billion mark. But George Carter is not worried; he points out that all the people on the earth would not fill the inner gorge of the Grand Canyon and couldn't even be seen from the rim.

More important than their differences though is the common concern of these and other scholars: that man learn to live in harmony with his environment and his fellow man, that the earth be made to yield abundance for all.

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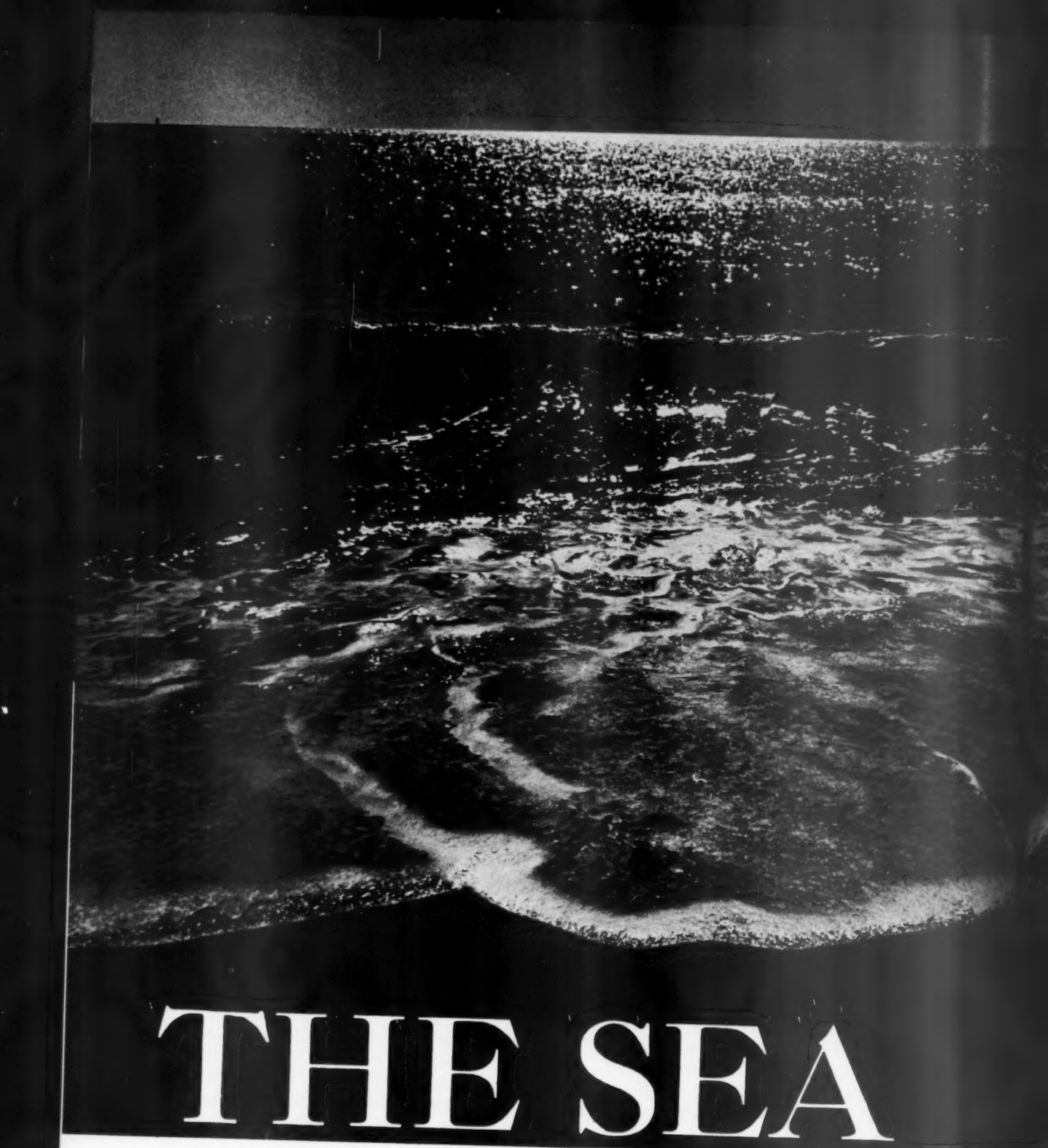
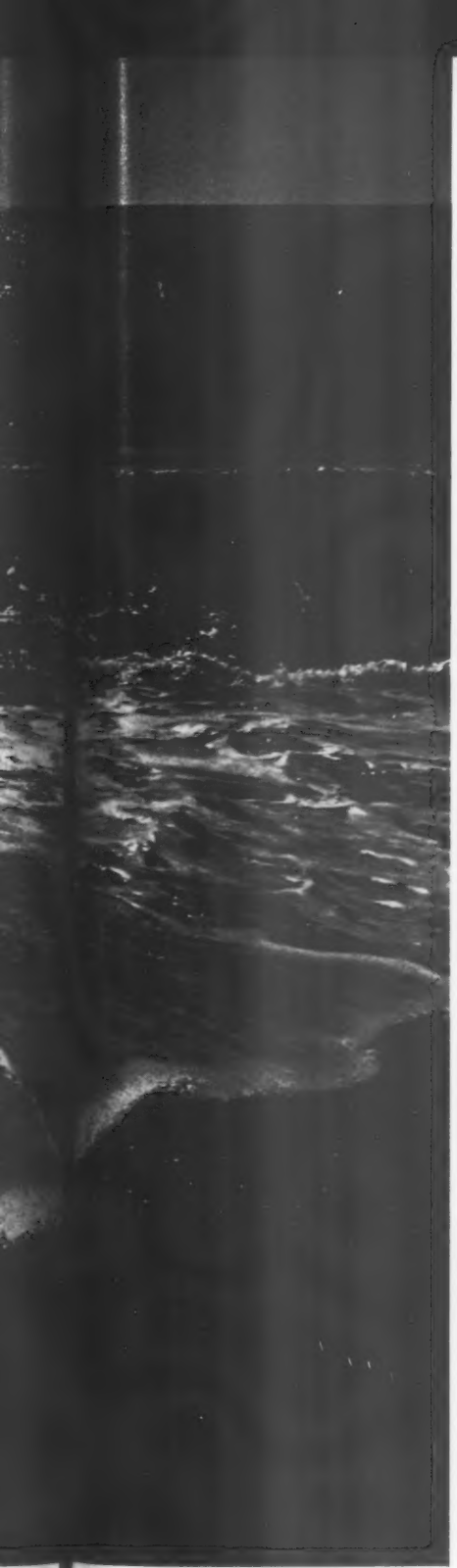


THE SEA

In the sea we find posed t dle
within its depths we may fi swe



d t dle of life and

y fi swers long sought.

By RACHEL CARSON, M.A. '32

THE ENDURING sea is many things to man, a latecomer to the earth. By its very immensity, its majesty, its ancient unchangingness and its beauty, by the challenge of all that is known and mysterious within it, the ocean grips our imagination and stirs our thoughts and emotions.

Only the present generation of men is beginning to realize its true significance—a generation schooled by the harsh necessities of war at sea, confronted by the disparity between expanding populations and dwindling food supplies, impoverished as the mineral resources of the land shrink under relentless exploitation.

Now to an ever-increasing degree the world is turning to the sea for solution of some of its practical problems—for new reserves of protein foods, for minerals not only locked in sea water but also scattered over the ocean floor, and for perhaps the most precious of all the sea's resources: water.

We may also take from the sea less tangible things. Exploring its hidden depths we learn the geography of a hidden land that we must learn to use for peace, not war; we glimpse the forces that have shaped the history of our earth and will direct its future; we gain awed comprehension of the dynamic power that resides in the rhythmic tides, the waves, the ever-flowing currents, a power so vast as to elude our understanding. It is a power to be sensed no less in all the varied and multitudinous stream of life to which the ancient sea gave birth, for in the sea we find posed the riddle and the mystery of life itself. Perhaps somewhere in its depths are the answers long sought by the minds of men.

Photographed for the Johns Hopkins Magazine
By Erich Hartmann, Magnum

©*Copyright 1961 by Rachel Carson*

At the low-tide line we enter a world as old as the earth itself–the primeval meeting place of land and water, a place of compromise and conflict, eternally changing, a place of challenge to life.

Adapting to the beat of surf and the ebb and flow of tides, early shore life evolved that endlessly varied stream of living things that has surged through time and space to occupy the earth.

Periwinkles today are midway in their evolution to land snails. The common periwinkle can live high on the shore, submerged only briefly at high tide. In a geologic tomorrow, it will have left the sea.

Tidepools are seas in miniature, retaining life-giving water when the tide has ebbed. Seaweeds help to absorb the shock of waves so that creatures of delicate structure and ephemeral beauty brighten the walls of the pools with color.

Molded by rhythms a

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Through countless millennia of adaptation, barnacles have found the perfect shape to resist the crushing weight of surf. Cementing themselves in infancy to the rocks, they avoid being washed away. Attached inside protective cones, the shrimplike barnacles thrust feathery arms into the water to sweep in the microscopic food contained in the rising tide, and thus live on wave-swept rocks where little else could survive.

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ere-fd, space, survival.

The ways of life on the shore are varied. Mussels, anchored to the rocks by tough threads, strain minute food organisms from the water when the tide is in, and in turn are preyed upon by starfish whose sucker-studded arms pull relentlessly until the shells spring open. Periwinkles are grazers, moving over rock, shell, and weed, endlessly scraping away the film of minute plant life with razor teeth.

At the edge of the sea man lives, also. As part of the mainstream of life, he was born of the sea and carries its salts in his bloodstream. Though he is now a creature of the land, his world would be uninhabitable without the oceans, the stabilizer of his climate, the vast reservoir of his life-giving rains. Man returns to the sea, his ancient home, for many things–for food, oil, minerals, as a highway for travel and commerce for all nations. Exploring it, he learns more about the history of his world, his universe.

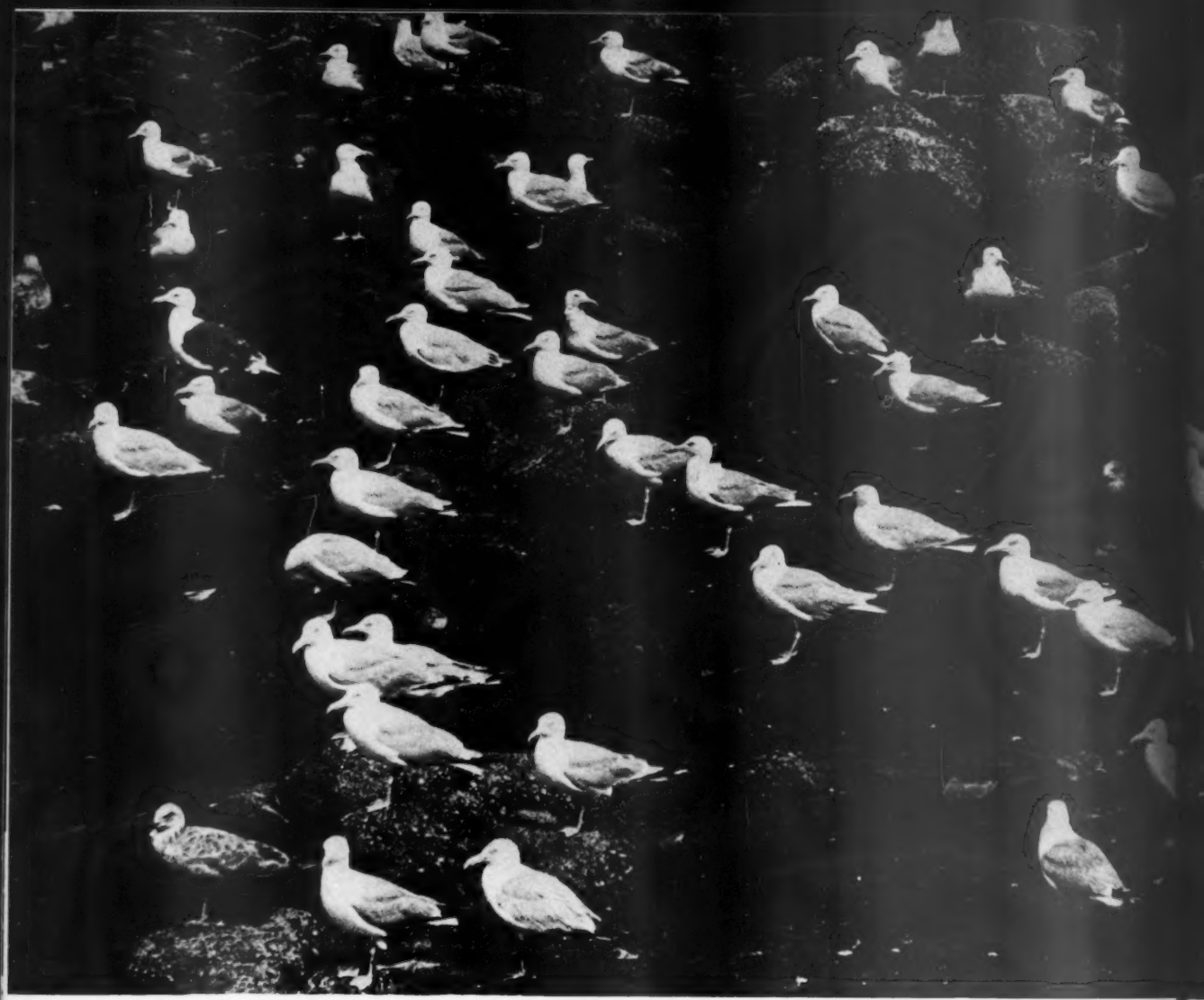
As evening comes to a New England fishing village, only the gulls remain alert. Sails are furled, engines quiet as boats rest at their moorings. With dawn, the scene will be alive with the activity of scores of pleasure boats and of fishing craft, from the ubiquitous lobster boats to the draggers, bound for waters outside.

Besides material things, we gain from the sea something of its own tranquility—a tranquility not found in the anodyne of the TV screen or the cocktail party—but in the repose of anchored boats after a storm, in the curve of a breaking wave, or on a shore untouched by man, alone with the eternal presence of the sea.

To a hungry world the sea promises great abundance. Man must learn to cultivate it, to mine the sea, to harvest it as he does the land. He must be bold and imaginative if he is to reap its vast wealth.

Those who live by and from the sea have learned to live *with* it, to understand and respect it. Between them and the sea a mystic rapport has grown and it is seen in their faces. They have come to depend upon the sea for sustenance. They venture out upon the water with nets and lines and lobster pots to gather its protein riches. And they return to the land, to the wharfs and the bleached wooden sheds to sort and clean their catch, to freeze or can it. Like their fathers before them, they look toward tomorrow and the living sea.

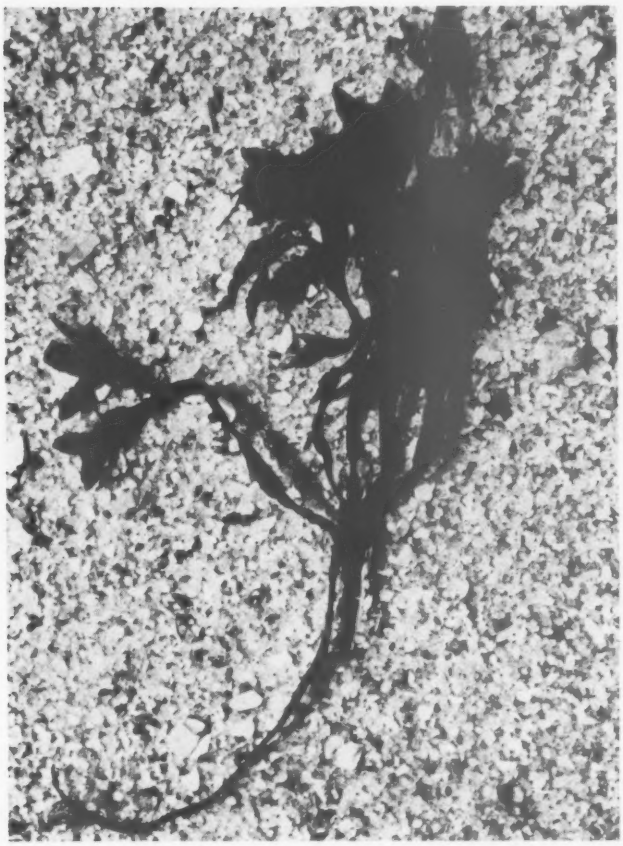
WINTER



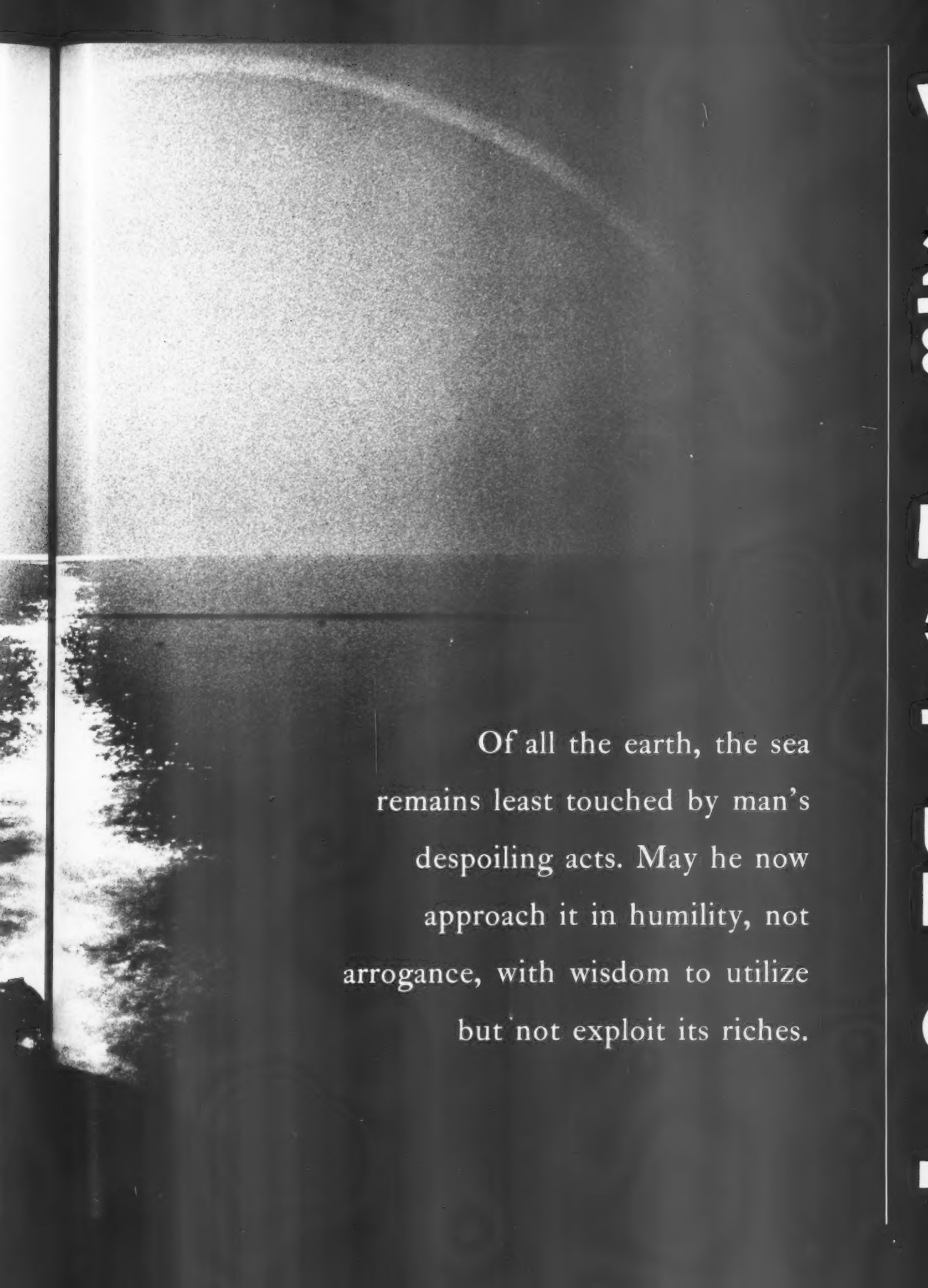
The sea's rhythms are eternal; nothing is ever lost. One dies, another lives, as the elements of life are passed on and on in endless chains. Atoms of calcium, borrowed years ago from the sea to form the armor of a mollusk, are released to the main reservoir, then later may be part of the delicate statuary of a coral reef. So individual elements appear again and again in different incarnations in a kind of material immortality, expressing the unity of life with life, of life with non-life.

Like watchful sentinels on the shore, gulls are alert for morsels brought by the tide. Along with other scavengers, they reclaim elements no longer needed by their former owners, continuing the cycle that has neither end nor beginning.

Sand is made from the slow decay and weathering of rocks, chiseled by frost, worn by water, carried at last to the sea to be ground and polished by surf. So continents dissolve and pass in grains of sand to the sea, restoring its minerals.



Links in the endless chain, gulls litter the shore with broken shells and crab claws. Lime from these fragments collects in pools, then is used by a tiny, one-celled plant that turns the water red by its abundance.



Of all the earth, the sea remains least touched by man's despoiling acts. May he now approach it in humility, not arrogance, with wisdom to utilize but not exploit its riches.

THE PROMISE

DRAWING BY LUN HARRIS

SE OF THE SEA

By WILLIAM D. McELROY

MAN'S dominion of the earth ends at the shorelines of the land he inhabits. Beyond his terrestrial kingdom—a meager one-third of the planet—lie the vast, unconquered oceans. The sea is a world unto itself: In its protective depths live ninety per cent of the earth's different kinds of animals; it produces all its own food—about ten billion tons of organic carbon a year, only a tiny fraction of which is harvested by man; it claims inorganic riches which stagger the imagination—enough gold, for instance, to make every man on earth a millionaire.

Fear and ignorance have kept man from this alien world of the sea. Throughout history, from Odysseus to Piccard, the sea has been, first and foremost, the province of men of rare courage. Not until great sea explorers crossed frontiers and conquered ignorance and superstition did others venture across the oceans or into its depths. As familiarity grew, man learned the commercial and military importance of the sea, and these in turn spurred greater mastery of the sea. As elsewhere, necessity became the mother of invention.

To the curious and the courageous, the sea still presents the challenge of the unknown, for ignorance is still the distinguishing characteristic of man's relation to the sea. But now, more than ever, necessity goads us onward in our exploration of the sea. We now have submarines capable of steady submergence for many months holding missiles capable of destruction many times greater than that wrought by World War II. For strategic reasons, therefore, we need urgently to learn more about the topography of the ocean bottom, about deep ocean currents, temperature, density, and so forth.

Quite apart from the threat of war, another necessity presses us to learn to master the sea. That necessity is basic to life itself: food. The lives of two-thirds of the world's people are wholly dictated by that basic necessity; they are oppressed by hunger and by the weakness and disease which hunger generates.

Out of the sea we can extract the food to relieve the hunger of these millions of people and give dignity to their lives. We *must* turn to the sea, because the bounty of the land has limits. And in some places—significantly, places where malnutrition is most chronic—the limits have been reached.

IT IS true that a lot more food than we are currently producing can be raised on the land. It is estimated that an additional one billion acres of land, though largely inferior to present cultivated land, can be put to agricultural use. Theoretically, the yield from this land can match the high yield per acre of present day Western Europe, though in practical terms, this will be a fantastically costly enterprise. This would be a level of productivity twice the present world average.

A rate of increase in agricultural production of two per cent per year is quite practical (four per cent per year is possible), so that doubling of productivity can be achieved within fifty years. But two per cent is barely ahead of the rate of population increase in the world, and may in fact fall behind it. Add to this the consideration that per capita consumption of food must increase in a number of areas of the world, and that industrial and urban civilization will crowd the agrarian, and it is obvious that we must squeeze an even higher yield from the land to feed the world population fifty years from now.

Surely the saturation point of land agriculture will have been reached a century from now; most likely it will occur sooner. The day is not far off when we must turn to the sea for a large part of our nourishment.

But in fact, the crisis is more immediate. Essentially the problem of today's hunger is not one of production, but of distribution. In many areas of chronic malnutrition, the saturation point of land agriculture is near. In China, two-thirds of the land is desert or mountain territory, unadapted to agriculture. The Chinese population is crowded into the relatively fertile eastern part of the country on farms which average 4.18 acres (compared to the average of 157 acres in the United States). Here they scratch a bare subsistence from the soil—whenever famines, floods, or locust plagues do not destroy the crops. The diet is almost entirely rice. There are few grazing animals on this precious land, since the conversion of vegetable calories into animal calories is far too costly; the recovery in milk, for example, is 15 per cent; in eggs, 7 per cent; and in beef, only 4 per cent.

Ironically, the Chinese population is concentrated close to the sea, where the animal proteins they so sorely lack could be easily fished from the waters. Moreover, a great reservoir of nutrients to enrich their soil lies in the sea, but China's impoverished medieval economy makes little use of these riches.

Similarly, protein starvation plagues areas of Latin America, South Africa, India, and Indonesia—and all of these areas are close to the oceans of the world. They present a startling contrast with Japan, which, though not agriculturally self-sufficient, has by far the largest fishing industry in the world. Significantly, 45 per cent of the proceeds from that industry go into fertilizers for land farming. In addition, Japan has pioneered in the cultivation of certain algae as human food.

For the sake of the billion and a half who are hungry, we need urgently to turn to the sea. We need the foods the oceans can provide directly; we need the mineral salts and organic nutrients to enrich the earth's soil; and we need fresh water extracted from the sea to irrigate our parched, unused land.

SOME OF THE barriers to fuller exploitation of the sea have been merely economic. There are regions of the sea where fish abound but no fishing boats scoop them up. Countries like India lack the capital to develop an efficient, large-scale fishing industry. Desalination of ocean water is practicable; several processing plants have already been built in this country, but they have been costly to build and the yield is still fairly expensive—about a dollar per thousand gallons.

Nonetheless, the greatest barrier is still our ignorance. We simply do not know enough about the sea as it is, much less how to manipulate and use it efficiently.

Like the land, the sea is varied. It has rich and fertile pastures and "dry" deserts. The life of the sea is subject to disease, depredation, erosion, and weather. There are seasonal changes and yearly cycles, which sometimes alter drastically. A species of fish suddenly changes its migratory habit. Why? We do not know. With respect to the sea, we are in the position of early man, who hunted and foraged on the land and accepted, because he had to, the conditions he met. We do not know how to enrich the "soil" of the sea, how to prevent fluctuations in abundance, how to combat marine diseases, how to practice selective breeding and develop the best species of marine life. As Lionel Walford has pointed out, "We are too ignorant of the sea and its resources to know how to intervene to the degree possible in farming. We cannot do what agriculturists do; we cannot manipulate the environment. Nor will we until we have acquired a great deal more knowledge than we now have."

The information we must gather will have to be *basic* knowledge about the sea; the practical knowledge cannot be attained without it. We must know the environment before we can manipulate it. And there are as many different aspects to the problem as there are "branches" to the broad science called oceanography: physical, chemical, meteorological, zoological, bacteriological, and so forth.

WHERE DO we start? The chain of life in the sea begins with the tiny plant organisms, called phytoplankton, which form the "grass" of the sea. The phytoplankton are consumed by tiny animal organisms, called zooplankton; both, in turn, are consumed by larger forms of marine life. Smaller fish are eaten by larger carniverous fish and sea mammals—and so on, up through the blue whale, which consumes a huge diet of zooplankton. Lastly, animal wastes which decompose and oxidize provide nutrition for the phytoplankton, and the cycle begins again.

A single copepod, one of the many kinds of zooplankton, may consume more than 120,000 plant organisms in a day. There is, of course, some energy loss in the process; a further loss occurs when the copepod is eaten by a larger animal, and so on up the ladder; by the time a fish has fattened himself to a size suitable for human consumption, an enormous output of basic energy by phytoplankton has been expended. Fortunately, these organisms multiply prodigiously under favorable conditions. One diatom may have 100 million descendants in thirty days.

Like the green plants on the land, phytoplankton, in the presence of sunlight and chlorophyll, use carbon dioxide and water to build nourishing carbohydrates from their own molecules and to release free oxygen—thus providing animal life its basic fuels. This process of photosynthesis is complex and mysterious; we do not yet understand it well enough to duplicate it in the laboratory, but we do know a great deal about its essential ingredients.

In addition to supplies of water (which, it is safe to say, will never be exhausted in the sea), photosynthesis requires sunlight. For this reason, plant life in the sea exists in a thin layer at the surface—seldom deeper than two hundred feet, and never deeper than six hundred feet. Temperature also influences photosynthesis. The other essential ingredients are carbon dioxide and the organic and inorganic nutrients in the sea water, which the phytoplankton use to reproduce themselves and to manufacture the complex chlorophyll molecule, the indispensable catalyst in the photosynthetic reaction. The range of elements used by these simple organisms is impressive. In addition to the common "building blocks" of organic compounds—carbon, oxygen, hydrogen, and nitrogen—these phytoplankton use phosphorus, calcium, copper, zinc, and a number of other elements. Recent studies have also shown that they need certain vitamins and amino acids.

Obviously, if there were no movement in the sea, the plant life would quickly use up all the nutrients near the surface and die. Fortunately, the sea is never still. Winds, temperature changes, and deep-sea currents induce turbulence, or upwelling, which draws the nutrient-rich deep waters toward the surface to replenish the "soil." In coastal waters, where movement occurs regularly and where land erosion provides rich nutrients, the sea is a rich pasture. Most of the important commercially interesting marine life is harvested in coastal waters or in off-shore waters not far from land. In many other areas, where movement is sluggish or where nutrients are sparse, the sea is a desert.

THERE ARE a number of problems which must be mastered before the deserts of the sea can be made fertile and the rich pastures made even more productive. We must learn, for example, which species of plankton are most favorable to the growth of commercially important marine life. These will vary with the climate of the oceans.

Some species, we know, are downright harmful. The "red tide" of the Gulf of Mexico, which poisons fish and piles them up on the beaches as thickly as one hundred pounds per foot, is caused by the sudden and mysterious "population explosion" of a certain dinoflagellate. Obviously, to discourage the growth of these harmful organisms and to encourage the growth of the best ones, we must know *how* they grow. And we are far from having that knowledge.

In the regions where upwelling is sluggish, we must learn how to speed it up. Scientists have suggested a number of ways to do this. One proposal is a floating chain, to which are attached huge metal flaps; deep currents would cause the flaps to wave, inducing motion all the way to the surface. Another proposal is a nuclear reactor, deep in the water, generating heat to force water upward by convection. These are some of the imaginative suggestions, but none has yet been tried.

Nor do we yet know enough about the topography of the ocean bottom or the action of deep-sea currents to use

natural endowments to assist future efforts at artificial upwelling.

As selective breeding must be practiced with the simpler organisms, it must also be practiced with higher species. The kingdom of the sea must be divided into those species which are commercially useful (a far greater number than we are presently using), those which contribute to the growth of useful species, and those which play no useful part or are harmful. We must learn what habitats are best suited for the growth of the best species, and then learn how to create those habitats and hold them constant. At the same time, we must control the habitat in such a way as to discourage the growth of harmful species.

The problem is like that of growing a field of plump tomatoes with the best fertilizers while inhibiting the growth of weeds which choke the tomato plants. The difference, of course, is that we know a lot more about tomatoes and weeds than we do about fish.

BUT THE minute we begin to tamper with the sea we raise a host of further problems. Despite the vastness of the oceans and their varied environments, there is a delicate balance to the life cycle of the sea. It cannot be disrupted at any one point without important consequences at all other points.

Fishermen know that underneath a thick patch of a certain kind of algae, herring will be scarce. For some reason, the fish run away from these too-rich waters. Nature sees to it that the algae growth is controlled and the plants consumed for good use, but if man were to enter the scene and promote the growth of the algae far beyond Nature's bounds, the consequences could be disastrous.

There may be another danger in thickening the carpet of plankton at the surface. As the density increases, the sun penetration diminishes, and the layer becomes thinner. Since the world of the sea is roughly divided into horizontal layers, each dependent upon the others but with definite boundaries for marine life within each layer, a disruption of the top layer can seriously affect all beneath it.

Again, there may be a danger if we begin, as some have proposed, to mine organically concentrated deposits of metals from ocean water on a large scale, for we may rob phytoplankton of valuable nutrients.

There is also reason to believe that wherever we tamper with the energy and matter exchange at the surface or change the upwelling rates in the ocean depths, we will affect the earth's weather patterns on a vast scale. Hopefully, we can enrich the seas and improve our weather at the same time, but we have no guarantee that the two considerations work to mutual advantage.

The very complexity of these problems underscores the need to attack oceanographic research on a broad front. Geophysicists, chemists, bacteriologists, and innumerable others must provide pieces to the huge puzzle before mankind can begin intelligent and safe, large scale farming of the sea.

As a footnote, it is worth mention here that, in one manner, mankind has already begun tampering with the sea with greater haste than his present knowledge warrants. In the last decade, we have dumped about 10,500 curies of radioactive wastes off the Atlantic coast and about 14,000 curies off the Pacific coast. Weapons tests have deposited more than two million curies of strontium-90 in the sea. As consumption of radioactive materials increases, especially with the advent of nuclear powered ships, the rate of disposal in the sea will rise sharply. By all our calculations, the present rate of disposal seems safe, even arch-conservative when matched against current British practice, which permits disposal of wastes through a three-mile pipeline directly into the Irish Sea at a maximum of 10,000 curies per month.

But our calculations have been based on limited information—insufficient to permit a great increase in the rate of dumping contaminants in the sea. Not enough is known about ocean currents to know where and how fast the contaminants travel through the water from disposal sites. Not enough is known about man's radioactive tolerance, both pathologically and genetically; almost nothing is known about the limits for all forms of marine life. Nor is enough known about the ability of marine organisms to absorb certain isotopes into their own structure to high concentration; clearly, some of these could be dietary hazards to man.

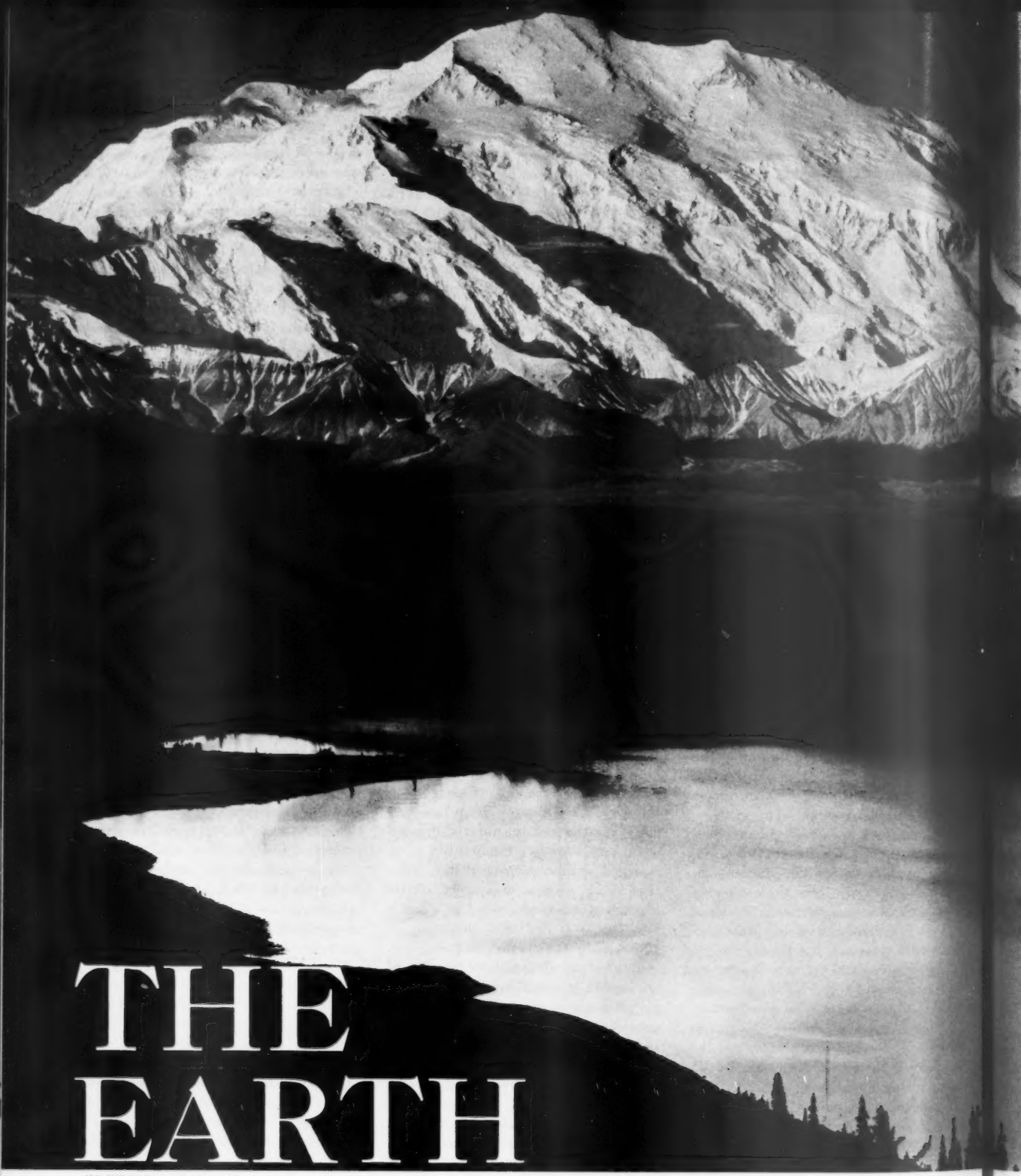
If we continue to limit ocean dumping to low-level wastes, and if the wastes were to disperse evenly throughout the vast ocean waters, the effects would probably remain negligible even if the dumping rate were increased many times over. But radioactive wastes obviously are not evenly distributed, and do create local, short-term problems. A number of scientists, including members of the staff of the Chesapeake Bay Institute of Johns Hopkins, are studying these problems, but a great deal more research will have to be done before the hazards are eliminated. As one of them has said, "The situation is urgent but not hopeless. There is time to make up our deficiencies, but no extra time."

EXPERTS AGREE that we have lagged in our study of the sea. We know more about the far side of the moon than we do about many regions of the oceans. By one estimate, it would take thirty-four research ships working ten years just to fill the gap in our knowledge of the physical structure of the oceans. And physical oceanography is but one aspect of the broad problem of understanding the sea and turning that knowledge to good use. Much of the work to be done will be accomplished in quiet and undramatic ways in laboratories far from the shorelines.

The Committee on Oceanography of the National Academy of Sciences, of which Harrison Brown is chairman, has recommended "at least a doubling of basic research activity during the next ten years" by the United States. A bill to sponsor a comprehensive ten-year program of oceanographic research was introduced in the Senate last year by Warren G. Magnuson, and the bill follows closely the studied recommendations of the N.A.S. committee. Hearings on the Magnuson bill are still in progress.

"For the first time in history," Arnold Toynbee has written, "mankind has dared to believe that the benefits of civilization could be made available to the entire human race." If the increased effort in oceanographic research is forthcoming, as it must be forthcoming, we may see the day when the sea is mastered, hunger is conquered, and dignity is granted to the lives of every human being.

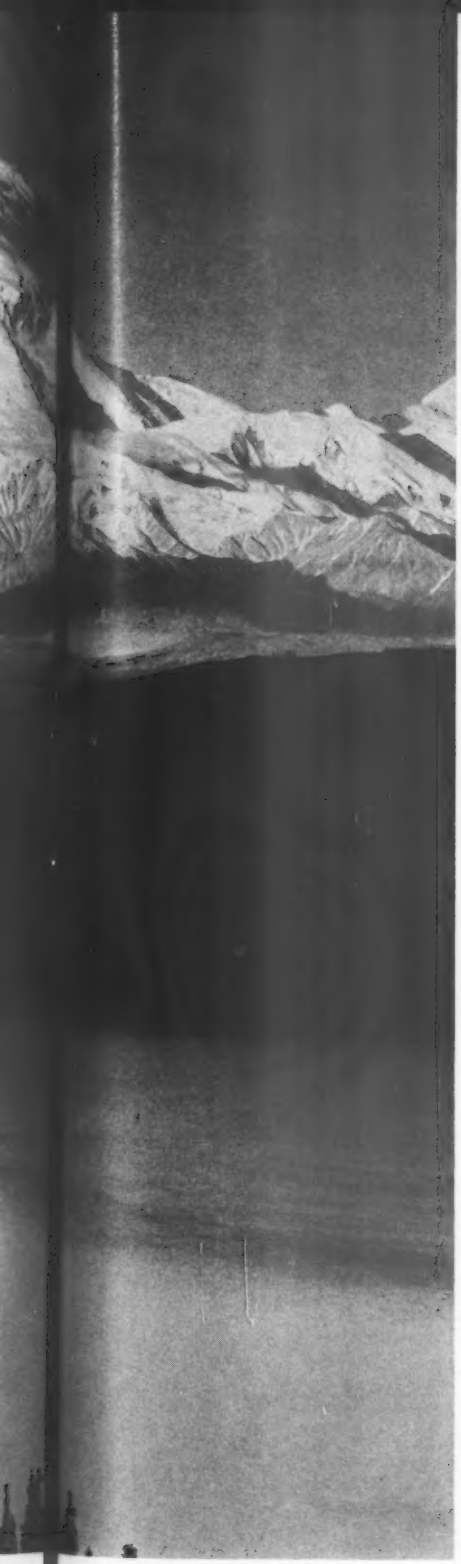
Only then will man's kingdom encompass the whole planet.



THE EARTH

MT. MCKINLEY—ANSEL ADAMS

The first man found a varied w f i
extremes–a primeval world, b ng



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ng and forbidding.

By GEORGE F. CARTER

IN SOME dim and distant era countless eons ago a cataclysmic solar phenomenon produced this planet. Whether the earth began as a whirling sphere of flaming gases or a cloud of frigid dust, the result was the same: the improbable creation of a planet large enough to hold an atmosphere, rotating on its axis to expose all of its surface to the sun, close enough to the sun to be warmed, far enough away to escape being scorched.

Vast and turbulent seas covered the earth in the beginning. Within their depths, atoms linked up to form increasingly complex minerals which, in the course of millions and millions of years, miraculously evolved into living matter.

The first living things that crept from the sea entered a world of silent stone. Great barren mountain ranges rose from the wrinkled, rocky surface and eroded steadily under wind and rain, washing back to the seas. Then life, perhaps a kind of seaweed, reached out and rooted itself to the rock and began for the first time to make soil out of the crumbling stone.

For millions of years, the plants and animals that had emerged from the waters changed the face of the earth. Across the bleak rock, a creeping cover of vegetation spread, seeded, blossomed, and spread further. As time passed, the earth became less angular. Beneath its layers of soil, the remains of life were compressed into coal measures and petroleum reserves. Salt deposits, mineral ores, and other bodies were segregated out in the crust of the earth. And when man arrived on the scene less than a million years ago, he found a world much like that of today. He found a varied world of immense extremes, of lush rainforests and arid deserts, of rugged mountains and flat plains, of steaming tropical heat and icy arctic cold—a primeval world, beckoning and forbidding.

SAND DUNES IN SAUDI ARABIA—STANDARD OIL COMPANY (N. J.)

ESKIMOS IN CANADIAN ARCTIC—RICHARD HARRINGTON

AFRICAN WOMAN AT A WATERHOLE—WHO

Man settled across the land and was buffeted and molded by his environment until he became as varied as the earth itself.

FROM THE TIME of man's appearance, the extremes of the earth sculptured him into biologically divergent races. For great periods of time he lived in isolation—some under a burning sun, until their skins had grown dark and their hair kinky; others in wind and snow until their complexion turned fair and their bodies thick and slow to lose heat. The physical environment imposed its demands on man, forcing his body to adapt or perish. It molded his mind, too, but in a different way, for while differing physical environments brought forth differing body forms, all environments demanded in man the ability to react quickly and surely. And the struggle between man and his world sharpened his wits and honed his mind without regard to climate or soil.

And so men settled on the quarter of the earth's surface that was not under water. There were limitations: Nearly a fourth of the land lay high above the sea where the air is thin and cold; a fifth of it lay dry beneath a burning sun, useless without water; and masses of land lay frozen beneath the polar ice. Yet men spread across the world; some lived in sands and in snows and on mountain slopes. And descending generations clung tenaciously to the land where they were born, for apparently no other reason than that they were born there. They drew sustenance from the land they occupied, often eking out a harsh existence from the unyielding earth. Then about ten thousand years ago, with the invention of agriculture, man sought out the fertile lands. Here he settled and multiplied, and today, half the world's people live on only one-thirtieth of the land surface of the earth.

Undoubtedly man today bears the marks of the immense time spent in differing environments. The world has buffeted and molded him in one way or another through all these millennia. But that is not the whole story; man is not simply inert clay to be pressed and shaped. He, too, has made some marks. He too has laid a hand upon his world, and this is by far the most important theme in the drama of man's existence.

ISRAELI FARMER—ERICH HARTMANN

TERRACE FARMING IN NEPAL—WHO

NEW YORK CITY—WERNE

Man makes his own worl

THE STORY of man's habitation of his planet is a story of illogic and contradiction. It is a story which yields few answers and many questions: How does a civilization begin? Why? What makes men sink roots in sand, snow, on mountain sides? Why do some men starve on soil which feeds others plentifully?

If there is a dominant note in the history of man, it is that he makes his own world. He built the great Egyptian civilization in the deserts of the Middle East, but in the almost identical desert along the lower Colorado River, he produced virtually nothing; and in the desert of Southwest Africa, man has remained in the Middle Paleolithic stage of hunting and gathering. The American arctic supports a handful of semi-primitive Eskimos, but the interior of Inner Asia, where temperatures can drop to 122 degrees below freezing, has produced explosions of human energy and creativeness like the empire of Genghis Khan. The inhospitable

LOS ANGELES—MARC RIBOUD

HONG KONG—BRIAN BRAKE

EGYPTIAN FARMER—ELLIOTT ERWITT

WHEAT HARVEST IN MIDWESTERN U.S.—ERICH HARTMANN

...pending on his ideas, it may be one of plenty or one of poverty.

Andean Highlands, with thin air and arid cold, produced the magnificent Inca civilization, while similar mountains in New Guinea have seen nothing but savage tribes who have barely felt the tremors of the agricultural revolution.

For further proof that man, not environment, is the dominant force, one may look at the contrast between the United States and Brazil. Too often, it has been said that a splendid natural environment made America great. In truth, this is a mediocre environment at best: One third of the country is arid; the West is a land of rugged mountains; New England is so poor a prospect that land once cleared and farmed has been abandoned to the spreading forests. The first Americans lived on a narrow coastal plain crossed by rivers navigable only below the fall line; the Ohio ran the wrong way and the Mississippi was controlled by foreign powers. America began on a strip of land poor in resources, harassed by sub-arctic winters in the North and super-tropical summers in the South. Not until the middle of the nineteenth century did she discover her natural wealth and by that time her cultural pattern and unique political system had been formed.

Brazil, in contrast, has twice as much potentially useful land, is well watered, has almost no mountains, possesses the great Amazon and a network of navigable rivers, has coal, iron, and oil. Brazil produced sugar when it was an expensive luxury, supplied half the world's gold for a century, produced rubber, chocolate, and coffee, had one bonanza after another, but is a second-rate power and does not even feed herself.

The difference is ideas—their spread, the acceptance or rejection of them. Only recently has Brazil begun to create the mental climate that will permit ideas to make her one of the great powers of tomorrow. Too many other nations have yet to take this step.

HUNGER IN INDIA—WERNER BISCHOF

Too many people live in poverty untouched by or unreceptive to new ideas, thus slaves to their environment.

ONCE, distinctive cultures grew from centuries of isolation, and a way of life took hold that was not easily uprooted. In such closed societies, new ideas were looked upon with suspicion and were resisted. As remarkable an invention as agriculture took five thousand years to spread from the Near East to Northwest Europe. It has been estimated that then ideas moved at the rate of about one mile per year.

Even where natural barriers provided no isolation, man frequently impeded the flow of ideas by establishing boundaries. He drew imaginary lines, often without knowing the nature of the area he dissected, and the boundaries often divided precisely where they should have united. The results were often tragic, and they lie heavily upon us even now: The invisible line separating Mexico from the United States is a century in breadth; the boundaries etched by man on the continent of Africa cut through tribal units; those in Latin America, like those in the United States, are accidents of history, reflecting realities of past times more than the present. Even industrial Europe has been kept divided and weak by invisible lines stronger than the great Wall of China.

The idea that made America great was that every man should be free to achieve what he could without infringing on the rights of others. Had this idea of individual freedom been prevented from reaching America and flourishing, where would the spirit, the courage, the boldness to subdue this land have come from? Men lacking such ideas had been here for at least thirty thousand years before the Anglo-American concepts loosed the social forces that made America out of the potentiality that had so long lain fallow.

The future will inevitably see vast areas of the earth changing and developing with incredible rapidity, for such key ideas as opportunity for individuals and such revolutionary forces as industrialization have yet to touch most of the world. Asia is caught in a current of change and confusion; Latin America is straining at the bonds of the past; and giant Africa, with its vast potential wealth, is beginning to stir.

What remains to be seen is how this revolutionary change will be accomplished, and herein lies a crucial turning point for civilization.

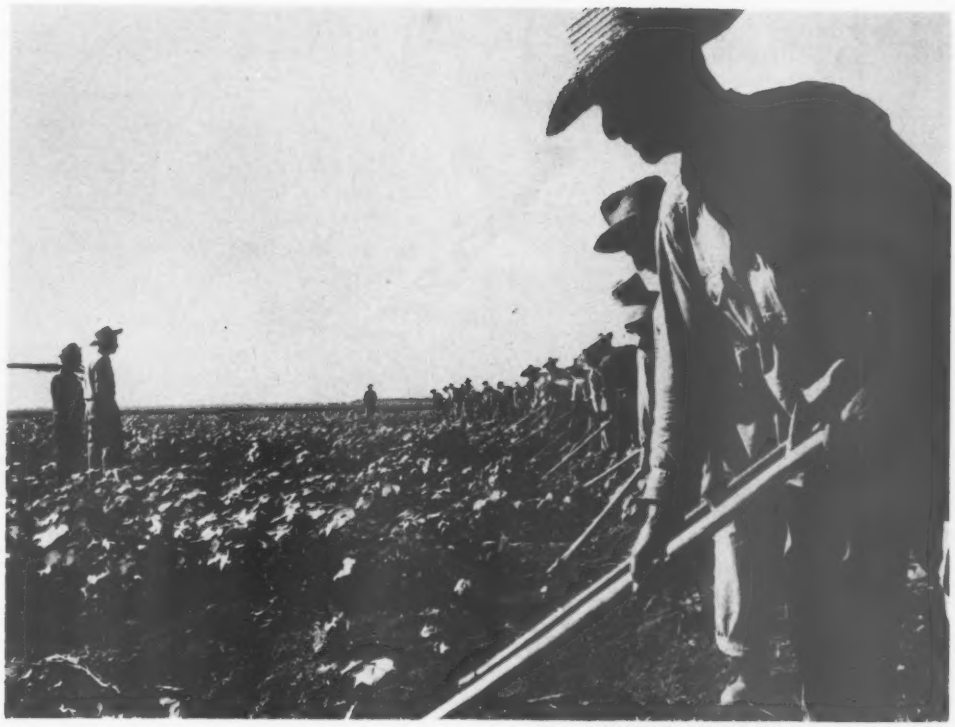
How will the destitute build a world of abundance? What ideas will shape the future? What will become of this fragile idea of freedom?

THE IDEA that every individual should have an opportunity to use whatever ability he might have is unique. Democracy may have begun with Greece, but ours is the first time in history that the idea of universal rights has been widely subscribed to. It is an idea which is foreign to many. It is an idea which is easily corrupted, always in jeopardy—an idea which needs to be taught anew to each generation. Shifting from a concept which limits opportunity to a privileged few to a concept which offers equality of opportunity to all is a revolution easily as great as the agricultural or industrial revolutions.

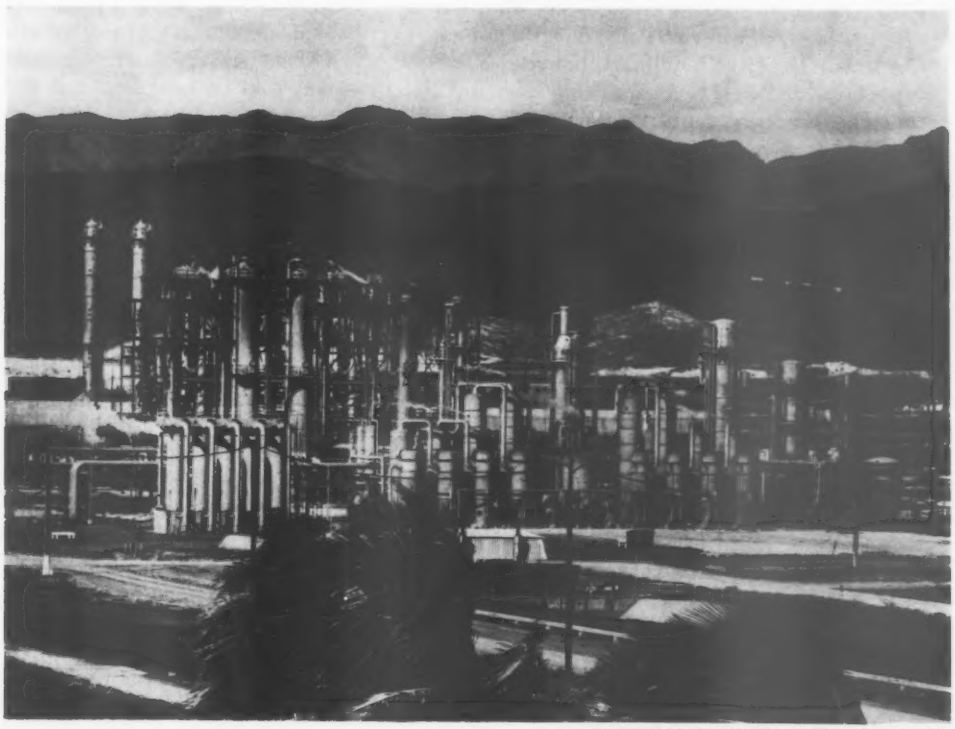
Three-fourths of the world's population live in misery and poverty. But they are beginning to see the promise of the future, and visions of a better life spark in them a determination to build for themselves a new world of abundance. The ideas of technology will spread swiftly across this shrinking globe to provide them with tools. But what of the non-technological ideas that will reshape their cultural patterns and change the world of tomorrow? What will become of this fragile idea of freedom?

The answer is in doubt, for the question is basic to the conflict that pervades these times. History makes clear, however, that if the abundance of the earth is to be reaped and shared to benefit fully all mankind, then the idea of freedom must prevail. We who have drawn strength and prosperity from this idea of individual liberty—especially America as the living example of its success—must first of all keep clearly in mind the real basis of this strength and prosperity. And we must demonstrate that the system which guarantees the freest access to ideas, which provides the most incentive and the greatest freedom to the greatest number of individuals, is the one which sets loose the immense creative forces of mankind. When such forces are released, it is the lesson of human geography that most of the world—even its deserts, its high mountains, its tropical rainforests—can be made to produce the necessities and comforts and even the luxuries of life.

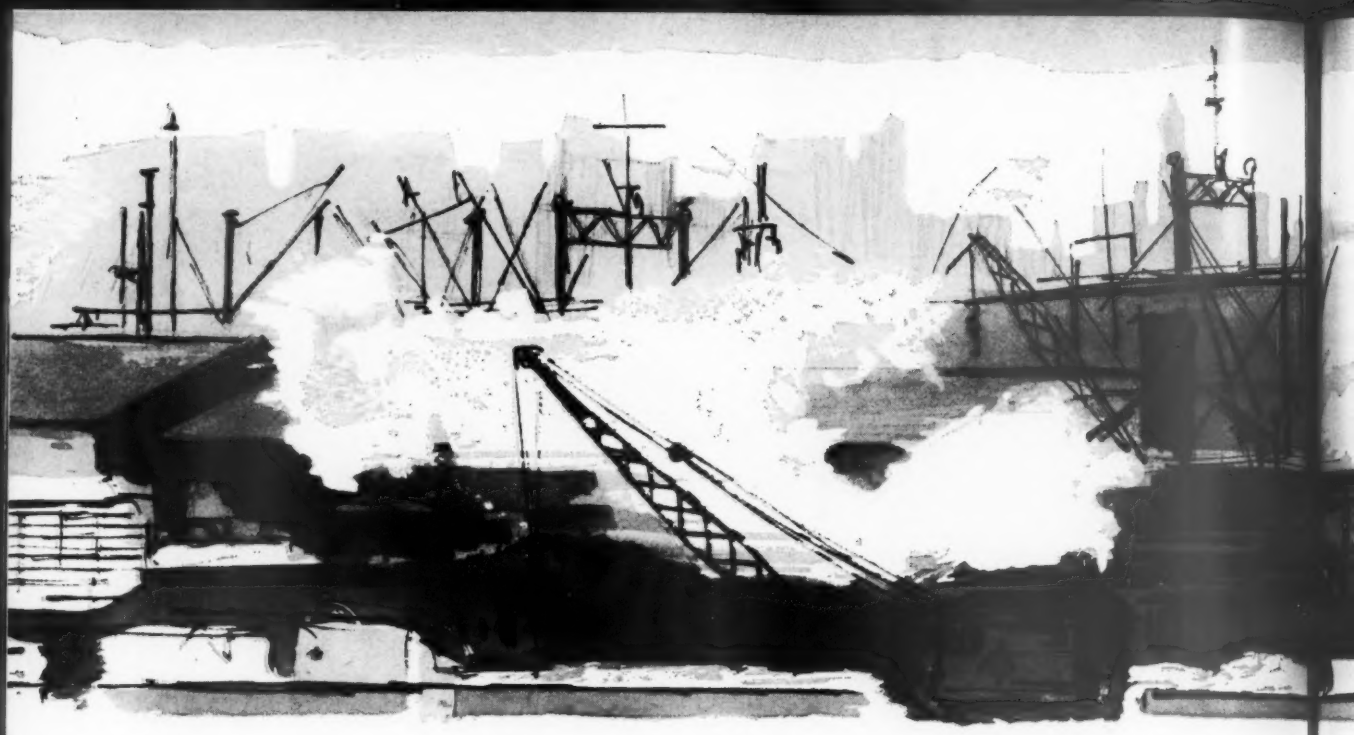
COMMUNIST LEADERS' MEETING IN CHINA—MARC RIBOUD



COLLECTIVE FARM IN CUBA—ANDREW ST. GEORGE



INDUSTRY IN PUERTO RICO—UNION CARBIDE CORP.



RESOURCES FOR THE

WHETHER WE like it or not, man has passed a point of no return. We have become completely dependent upon science and technology for our personal and cultural survival. I am not referring to our ability to build more powerful bombs or more sophisticated rockets; I am talking about our ability to make this planet support a rapidly expanding industrial civilization and an incredibly fast-growing population.

When man linked inanimate energy to the machine in the eighteenth century, he began a fantastic revolution, a great cultural mutation. Suddenly, he had unprecedented power. He could produce more goods, fabricate new ones, do more work with fewer man hours, go where he could not go before, and do what he could never before do. This dramatic step forward brought him to the edge of a golden age that promised to be the greatest in history.

During his first million years of existence, man's culture was essentially one of food gathering. People ate what they could capture; they dug for roots, picked fruit from trees, pulled fish from water, and gathered nuts from the ground. We know from studies of this type of culture (made before it became extinct) that fifteen square miles of land with normal vegetation were necessary to support a single human being.

Obviously, such a culture could support only a limited number of people, and the number in a particular colony was limited by how far a group of hunters could walk to fetch food before it spoiled. We can estimate that under the restrictions of the food gathering culture, the earth could support only about ten million people.

About six thousand years ago, man made his first great step forward with the invention of agriculture; this was a cultural mutation greater to some extent than the one we are going through today. Agriculture made it possible for a thousand people to live in an area which could previously support only one person. By allowing some people to provide food for others, it freed certain people to engage in other activities. Almost overnight, primitive food gathering societies became peasant villages, tilling the soil. Situated for the most part along waterways so they could transport food, the peasant villages gave rise to the growth of cities.

Even before agriculture had spread completely around the earth, man linked inanimate energy to the machine and began a new era. There is a striking parallel between the situation which existed many centuries ago and that which exists today. The contrast then was between the wealthy few in the agricultural society and the impoverished mass in the food gathering society. Now the contrast is between the wealthy industrialized minority and the great masses of impoverished people living in agricultural societies. Just as the agrarian culture spread across the world in that remote period, the industrial civilization of the present is spreading.

DRAWING BY LUN HARRIS

HE FUTURE

By HARRISON S. BROWN, PH.D. '41

Barring world catastrophe, it is destined to become world-wide.

We are much closer to the beginning of this second revolution than we are to its end, and we are faced with some perplexing questions which must be answered: How long can our rate of material progress and growth continue to accelerate? Where is the industrial revolution carrying us? What is the future likely to be with respect to the fantastic changes it has brought about? Can the earth support an industrial civilization of much greater dimensions and far more people than exists today? The answers are not easily come by, but in the long run they will determine whether our culture, our nation, our children live or die.

To see how far man has come in the industrial revolution, one need only look at the United States. With a technology more highly developed than any other nation, we have reached the point where 10 tons of steel are in use to maintain the living standard of each American. In addition, there is in use for each person in the United States about 300 pounds of copper, about 100 pounds of lead, and about 200 pounds of zinc. To keep all this metal functioning, we consume each year for every person the equivalent in energy of 10 tons of coal. Naturally, part of this energy is in the form of natural gas, petroleum, water power, etc. The demands for energy and raw material in an industrialized society are enormous. And they are increasing steadily. How large will they become? Well, it is rather clear that we haven't yet reached the saturation point of goods that people think they want to own. Our per capita consumption will increase, I suppose, until we run out of space to put the things we want to possess. But even were per capita consumption not to rise, the per capita quantities of materials in use will of necessity increase as time goes by, simply because we have to work harder in order to stay in the same place, just like the red queen in *Alice in Wonderland*.

WHEN MAN first began to use tools, he was able to pick up pure copper crystals from the surface of the earth. This situation soon changed. Man then had to dig under the earth for his copper ore, and naturally he sought out the high grade ore deposits that could be mined most easily. As a result, all known high grade copper ore deposits in the world are gone. To find the copper he needs today, man is processing the lower grade copper ore, and he is doing it at a much greater cost. At the turn of the century, the United States was processing copper ore with a mean copper content of 5 per cent. Now we process ore that is one half of one per cent copper.

Nothing fundamental prevents man from mining and processing low grade copper ore, but clearly a lot more technology must go into the system. Much more material must be moved; a lot more steel is required, as is

more equipment and more energy. So copper gets progressively more expensive in terms of kilowatt hours per pound of copper and in terms of the capital quantities of material in use.

The same situation is true with iron ore. If I were asked to name the single most important aspect of the North American continent from the point of view of the rapid emergence of our present culture, I would point to the fantastic iron ore deposits in the north central regions of the continent (the Mesabi Range). When industrialization first came to America, these iron ore deposits seemed infinite. Now, however, we can see the beginning of the end of them. What will we do when they are gone? We can do one of two things: We can learn to process the vast quantities of low grade iron ore available to us (taconites), and we've already begun investing in this alternative. Or we can go abroad for our iron ore. Processing lower grade ore takes a great deal more energy and equipment. Obtaining ore from abroad means building ships and expending energy to get the ore back to America. So no matter which alternative we choose, the quantity of equipment in use and the per capita expenditure of energy will of necessity rise—even if everything else remained constant.

As our easily accessible wide coal veins disappear and we are forced to dig deeper and deeper, we must spend more energy to get energy. The oil industry has reached this point, and now must drill down miles to try to find new domestic oil reserves. This is done at a high cost of energy and equipment.

Our use of water provides still another example. We have consumed more and more water until we have reached the point where roughly 10 per cent of our total stream flow is now being used. Consider that we started from zero and that we are on an exponential curve and being as high as 10 per cent is a little frightening.

It is clear, then, that the quantities of material in use in the American economy will increase enormously in the next fifty or a hundred years because we must work harder to stay in the same place, and because per capita consumption will probably continue to rise. It would not surprise me that in the next few decades we will be using 100 tons of steel per person, instead of 10. And that means a corresponding per capita expenditure of energy annually equal to the burning of 100 tons of coal.

I HAVE used the term "per capita" several times without discussing population. The population of the United States is increasing. Nobody knows how large it will become, but on the basis of the evidence we have, it seems highly unlikely that the population density will level off at a point much lower than that prevailing in Western Europe today. That means that roughly a billion people will be living in this country—five times more than at present. Where will they be living? In all probability in the cities. The area from Boston to Washington, D.C., already has a population density equivalent to that of Western Europe today. People tend to move from areas of high population density to areas of low population density, and the main migration is westward. We can expect within the next fifty years the appearance of nineteen new cities the size of Los Angeles, and eventually an entire urban strip around the country will be one vast city. Obviously, the complexities which arise with urban civilization will contribute to the increase in per capita energy expenditure.

The point I am trying to make is that the United States is approaching on a rapidly accelerating curve the time when we will no longer have high grade resources and will have to depend on technology to keep us going. We will have to find cheaper and more effective ways to process low grade ores and to recycle scrap metals. Considerable progress has been made in the former, and we are turning more and more attention to reclaiming scrap. Theoretically, if we were eventually to accumulate a sufficiently large quantity of each of the metals and were able to recycle metals with 100 per cent efficiency, it would no longer be necessary to produce metals from ore, except for enough to replace that which is lost through rust, attrition, sunken ships, etc. This is unlikely, however, since even with the best of techniques, we are likely to get a 10 per cent loss each time we recycle scrap metal.

THE SITUATION in the United States portends what will occur throughout the world. Industrialization emerged in Western Europe and jumped the Atlantic to America. More recently, we have seen it spread to the Soviet Union and Japan. Today, we see the process beginning in China and India and we hear rumblings of an impending industrialization in the greater parts of Africa and South America. And just as the food gathering culture could not co-exist with the agrarian culture, agriculture cannot compete with an industrial culture. There is no doubt in my mind that, barring a major world catastrophe, the world is destined at some point in time to be completely industrialized.

To get some idea what this will mean to the supply of raw materials and energy, multiply 10 tons of steel per person times the number of people in the world today. The figure is quite high, but not even comparable to the figure one gets when the rate at which the world population is expanding is added as another multiplier.

If by some miracle we could suddenly bring the rest of the world up to the living standard in the United States we would have had to extract from the earth about 18 billion tons of iron, 300 million tons of copper, an equal amount of lead, over 200 million tons of zinc, in addition to huge quantities of other metals and non-metals. These totals are well over one hundred times the present world annual rate of production. To put it in another way, all of the world's existing mines and factories would have to operate full time for over a century just to accomplish this miracle.

Clearly, then, we are at the beginning of this cultural mutation. The demands for energy and raw material in the world are increasing steadily and will continue to increase as industrialization spreads. It is equally clear that the United States and other industrialized nations will no longer be able to rely on outside sources for raw material—no more Chilean copper, Middle-Eastern oil, Venezuelan iron ore. Competition between nations for the relatively high grade resources remaining will become greatly intensified, and nations will have to get along with what they have within their own borders. One suddenly wonders if we are like bacteria in a bottle with a finite quantity of nutrient solution which at some point will be completely consumed, or if we, like a bunch of flies on a loaf of bread, will perish when the last crumb is gone.

Things are not quite so gloomy. The ultimate resources of energy (particularly solar and nuclear) available to

man are enormous—sufficient to power a highly industrialized society for literally millions of years. Given adequate brainpower and a reasonably stable political situation, man will ultimately be processing the very rocks of which the earth's crust is made.

Suppose that man *will* someday have to live off this lowest common denominator of the earth's crust. Can he do it? We became interested in this problem in our fuel chemical labs at Cal Tech a few years ago. We turned our attention to ordinary rock, and what we learned was interesting. An average hunk of granite contains about 4 parts per million of uranium and 15 to 20 parts per million of thorium. These are indeed small quantities, yet the uranium and thorium in a ton of average granite contains the energy equivalent to about 50 tons of coal. Furthermore, we've learned that the uranium and thorium are not uniformly spread throughout the granite; that about one third of it is localized in a loose form and can be gotten out with very little expenditure of energy—about the amount in a ton of coal. So we get the energy equal to 15 tons of coal at a cost of one ton of coal, and this is an enormous energy profit. Furthermore, the average piece of granite contains iron, a form of magnetite, aluminum, and most of the other elements needed to perpetuate a highly industrialized society. A world with ten times the present population living at the present American standard of living would eat its way down through the earth's crust in this way at the rate of a centimeter per millennium, and it would take quite a few millennia before we began to encounter serious difficulties.

IN PRINCIPLE, and on paper, we can keep going on the lowest common denominator without violating the laws of thermodynamics. Before we begin processing ordinary igneous rock, we will process richer than average rock. We will isolate an increasing fraction of iron from intermediate grade ores in abundance, such as taconites. As supplies of coking coal dwindle, iron ores will be reduced with hydrogen, produced initially from poorer quality coal, and eventually from sea water. Increasing amount of aluminum will be processed from clay, and sulphuric acid will be made from pyrites, then from gypsum. It is purely a question of energy and technology. This applies to feeding an industrialized world, too. I can visualize feeding as many as 10 billion people on this earth with modern, world-wide agricultural technology. Technically, it is probably possible to keep alive many, many more than that. I say "keep alive"—not make happy.

I've succeeded in convincing myself that the barriers to the emergence of a world of abundance do not lie in the limitations imposed upon us by nature. I believe that we can create a world of abundance for all which can persist for a very, very long time.

That doesn't mean we will! There are some tremendous problems. I worry, for example, about the way in which technological civilization may spread. India and China are bent on industrializing, and it is clear that they will have enormous difficulties. Many of their difficulties stem from the fact that it is very hard for a nation to increase agricultural production at a rate substantially greater than the rate of population growth. If, for instance, a population is growing at the rate of 2½ per cent a year, and food production is increased at the rate of 2½ per cent a year, then as time goes on, everyone has the same amount to eat. The only difference is that it gets more crowded. Food production must be increased, therefore, at a rate substantially greater than population increase. Even more important, perhaps, these changes must take place rapidly enough so that an improvement can be noticed during the life span of a single individual. If improvement does not take place during the course of a man's life, he becomes discontent and wants to do something about it. And what he does may be in imitation of what is happening in China today.

It is very difficult within the framework of what we like to call "individual freedom," within the framework of democratic processes, to take drastic steps which a country like India must take if she is going to improve the lot of the average Indian at a noticeable rate. The pressures, then, are overwhelming to ignore democratic processes, to become efficient, to use methods for controlling people and getting them to act.

Today, our technology has placed in the hands of national leaders weapons of persuasion and coercion of unprecedented power. The old-fashioned revolt of sticks and stones and muskets is no longer possible. The road to totalitarianism is a one-way street, and there is a real danger that the world of the future may be a highly regimented world.

There are things we can do to help countries like India go through this transition as painlessly and as smoothly as possible within the framework of democratic institutions, but it will mean pouring a great deal of technology into their system. And it is going to mean pouring a great deal of capital in the form of tools, energy, and raw materials.

MEANWHILE, the political pot will be simmering constantly. An industrial society by its very nature is extraordinarily complex. It requires an enormous network of mines, factories, transportation systems, and communications systems all linked together like a vast biological, ecological network. This is very sensitive to disruption. Should such a disruption come today, we could probably pick up the pieces and begin again. But let's suppose this network should be shattered after we have used up all the high grade resources and are completely dependent on a fantastically complex technology for our survival. If a nuclear disaster wiped out this industrial civilization and a new man came upon the scene from the trees, he would never be able to get things going again. He could not pick copper crystals from the earth's surface or gather coal. The raw materials vitally needed for civilization would be obtainable only with an elaborate technology—a technology which the new man wouldn't possess and wouldn't have the raw materials to build.

The future holds three distinct possibilities for man. The first is a reversion to an agrarian existence. This seems inevitable unless man is able to abolish war, stabilize population, and make the transition to new energy sources. The second is the perpetuation of industrial civilization through the complete control and collectivization of society. The third possibility confronting mankind is that of a world-wide free industrial society in which human beings live in harmony and abundance. This would be difficult to achieve and difficult to maintain, but it lies within the power of man. His past and present performance, however, gives little reason to believe that this third alternative is more than a remote possibility.

A SAMPLING OF RESEARCH IN PROGRESS AT JOHNS HOPKINS

Steps Forward

By his ingenious instruments, man has been able to probe into limitless space and to drill into the depths of his planet through two and a half miles of ocean water. Man himself has ventured 190 miles into space and seven miles into the ocean depths and survived. These are recent achievements. Ten years ago, man had ventured less than one-fifteenth as high, less than one-seventh as deep.

Man's home in 1961 is a band two-hundred miles thick encircling the earth. Is he master of it? Hardly. Most of his environment remains beyond manipulation, even beyond prediction. The earth beneath him, the seas around him, the atmosphere above him, and life about him: all of these doggedly hold their secrets.

Science explores these mysteries, and from the progress of science come the tools by which man gradually gains a stronger command of the physical environment. The lure for the scientist is often the mystery itself, but practical benefits are the natural, almost inevitable outcome of his efforts.

The practical possibilities are apparent in nearly every kind of research undertaken at Johns Hopkins. A geologist's study of the history of an area may bring forth new sources of water or minerals; a pathobiologist's study of virus cells may help overcome disease; an economist's analysis of lending policies may help to spur fuller use of available resources. And so on, *ad infinitum*.

On the next three pages are described six research projects now in progress at Johns Hopkins institutions. They are only examples, picked almost randomly, but together they illustrate one of the basic tenets of science: practical knowledge is dependent upon fundamental research and understanding.

THE METABOLISM OF PHYTOPLANKTON

The life of every marine animal is dependent, directly or indirectly, upon the tiny plant organisms which form the "grass" of the sea. Greatly extended use of the sea as a source of food is dependent, therefore, upon knowledge of how these plants, called phytoplankton, grow and feed themselves.

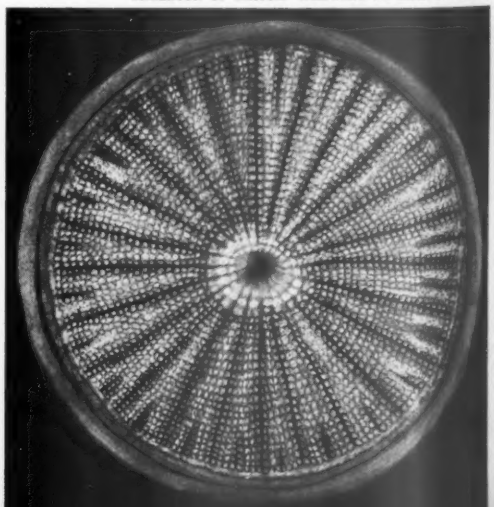
What nutrients are essential for phytoplankton, how much of each nutrient is required, and how these nutrients are put to use by the organism—these have been the concern of W. Rowland Taylor, assistant professor of oceanography. To learn what use a species of algae makes of a particular metallic nutrient, Dr. Taylor "feeds" the algae radioactive isotopes of the metal in question. These radionuclides are simply analytical tools; a zinc isotope, for example, can be assumed to react in the same way as "cold" zinc, but is easier to trace. Care has to be taken to distinguish actual nutritional uptake from mere physical absorption.

For controlled conditions, a pure strain of algae is suspended in synthetic sea water in a glass tank, gently stirred and kept at a constant temperature and under constant illumination. To test the effect of nutrients introduced into the water on the growth rate, the "normal" population must be kept stable; this is done by siphoning off older organisms at the same rate that new ones are formed.

Though of secondary consideration, Dr. Taylor's studies are also providing data of interest to those concerned with what happens when radioactive wastes are dumped in the ocean.

Eventually, to learn precisely how these nutrients are used, Dr. Taylor will break down the cells of the algae to see where the radionuclides are going.

SKELETON OF DIATOM—DRAWING BY HERBERT SMITH



VIEW FROM RESEARCH SHIP "MAURY"—WERNER WOLFF

A TRACING TECHNIQUE TO STUDY CURRENTS

AMONG THE most important kinds of information to be gathered from any natural body of water is knowledge about its currents. Precise data on currents can be invaluable to the fishing industry, navigators, and those concerned with pollution.

A new method for examining currents, superior to older tracing techniques, has been developed by James H. Carpenter, assistant professor of oceanography. A red pigment, called Rhodamine B, is introduced into the water at a given point; a continuous sample of the surrounding waters is then taken aboard the research ship until the pigment has been diluted beyond detection. The measuring device aboard ship detects the fluorescence cast by the dissolved pigment when exposed to a special mercury vapor lamp—so sensitively that it can detect .05 parts of pigment per billion parts of water. The pigment is highly soluble, non-toxic, and inexpensive; the cost of tagging one million cubic feet of water is about three cents. (This is at least ten times cheaper than the radioactive tracer technique.)

In the first application of Dr. Carpenter's technique in Baltimore Harbor, the pigment was carefully traced for six days; in that time, the material had moved forward six miles and spread laterally a mile and a half.

Besides widespread use in harbors and inland waters, Dr. Carpenter foresees possible use of his technique to study currents at proposed sites for dumping radioactive wastes in the oceans.

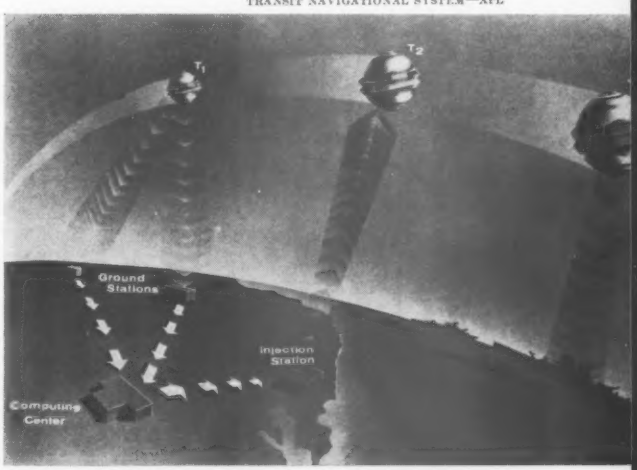
ALL-WEATHER SYSTEM OF OCEAN NAVIGATION

ONE OF the things which has kept man from mastering the sea is the difficulty he has had finding his way across the barren waters. Even today, methods of marine navigation are so inexact and inconstant that the important scientific work of charting the oceans is seriously hampered. Shortly, however, a precise, all-weather world-wide navigational system may become a reality.

The Transit system, conceived and developed by scientists at the Applied Physics Laboratory of Johns Hopkins, will employ satellites as navigational aids. Operating on the principle of the Doppler shift (which, in its classical example, is the drop in pitch of an approaching train whistle), the satellites will broadcast two tonally related radio signals, to be picked up by ships at sea. For a ship to compute its position, the "timetable" of the satellite—its exact position at a particular time—must be known. To gain this information, a number of tracking stations receive orbital data from the satellite as it passes within range. This data is transmitted to a central computer, which calculates the orbital path for the next day. An "injection station" transmits this timetable back to the satellite, which retransmits the information to ships at about ten-second intervals throughout the next day. Equipment aboard ship does all the necessary calculations, and gives the navigator his precise position.

It is estimated that four satellites in orbit will be sufficient to provide "fixes" anywhere on earth at intervals of about one and a half hours. Three experimental Transit satellites have already been placed in orbit in an effort to perfect the system.

TRANSIT NAVIGATIONAL SYSTEM—APL



THE USE OF DAMS TO PURIFY STREAMS

DAMS ARE BUILT on streams and rivers to supply electrical power, to irrigate fields, to furnish cities with water, and for a variety of other purposes. Too often in the past, little attention has been paid to the influence of dams on pollution abatement downstream. Rivers provide a useful and necessary dumping ground for wastes; dams can help or hinder this use, depending upon how they are managed.

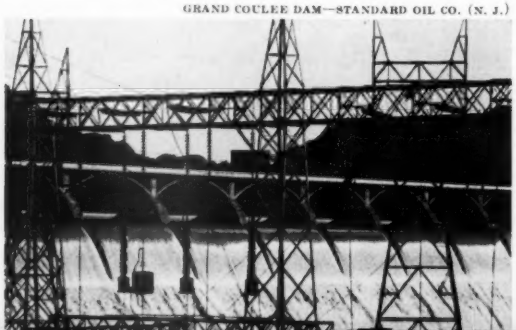
A naturally flowing stream has two mechanisms to take care of contaminants introduced into its waters. One is the flow of the stream itself, which provides for quick dilution and dispersal of the wastes; the other is dissolved oxygen, which decomposes many wastes and renders them stable. When a dam is built, new means must often be found to take care of contaminants downstream, particularly in dry seasons when flow recedes. Dams can, in fact, improve on nature's devices for self-purification of streams through "low-flow augmentation"—the release of stored water at the critical times.

Under what circumstances does this method become cheaper than other methods of pollution abatement? When low-flow augmentation is used, how *much* water must be released to take care of pollutants downstream? Is this more water than, say, a hydroelectric plant will desire to release? How much water should the plant be forced to release? Who should pay for the pollution abatement program: the government or the users?

These are some of the economic and legal problems; there are technical questions as well. How much of the dissolved oxygen in the water is lost when it is stored behind a dam? Is enough oxygen picked up by discharged water to take care of pollution downstream?

These, and other questions, are being investigated in a special project under the direction of Cecil H. J. Hull, research associate in the department of sanitary engineering. Among technical aspects, for example, Dr. Hull is currently studying the effects of temperature, atmospheric pressure, and other factors upon the capacity of water to dissolve oxygen. By combining legal and economic considerations with the purely technical, Dr. Hull's study promises to be a realistic guide for governmental agencies concerned with water use and conservation.

GRAND COULEE DAM—STANDARD OIL CO. (N. J.)



THE SELECTION OF SITES FOR PLANTING FORESTS

FOR A NUMBER of reasons, "silviculture," the planned management of forests, is still a young and foundering science. For one thing, timber, particularly on this continent, is not a scarce commodity and can be harvested from wild crops. Secondly, the fact that timber grows slowly and is subject to unpredictable effects like hurricanes and fires and fluctuating market demands, makes the wisdom of planning difficult to appreciate. And thirdly, the slowness of growth limits the pace of research. It is the wry admission of foresters that "We never live to see our mistakes."

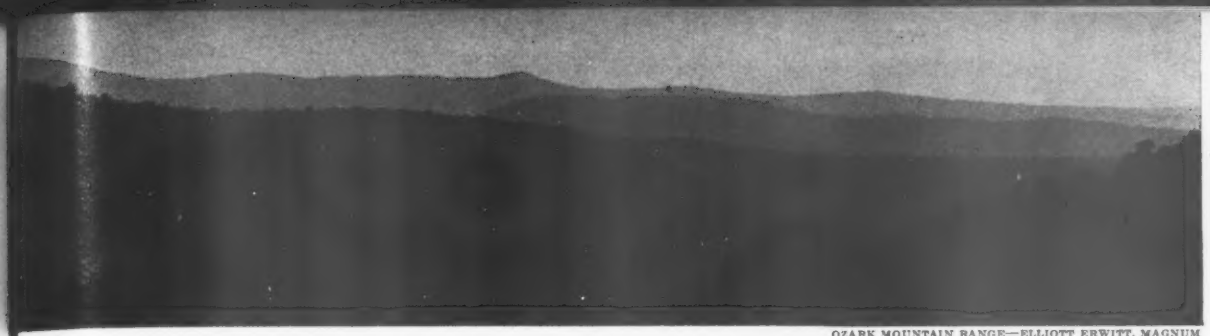
But in Europe and North America, wood is being consumed

THE COMPLEX CURRENTS OF THE ATMOSPHERE

NO PART of man's environment remains so annoyingly and expensively unpredictable as the atmosphere about him. Every year, the price of our ignorance about weather is measured in destroyed crops, frozen livestock, inundated homes, and lives lost in floods, tornadoes, and hurricanes.

The little progress that has been made in forecasting in the last few decades has largely been the result of improved means of observation, and forecasters still rely heavily on their statistics and weather maps. Too little attention has been paid to basic research, to an understanding of the simplest effects of rotation and of density and temperature variations. From the practicing meteorologist's point of view, one difficulty has been the remoteness of fluid theory; the equations, however apt for simple fluid phenomena, cannot cope with the complexities and disorder of real situations in the atmosphere.

Some of these deficiencies are beginning to be made up.



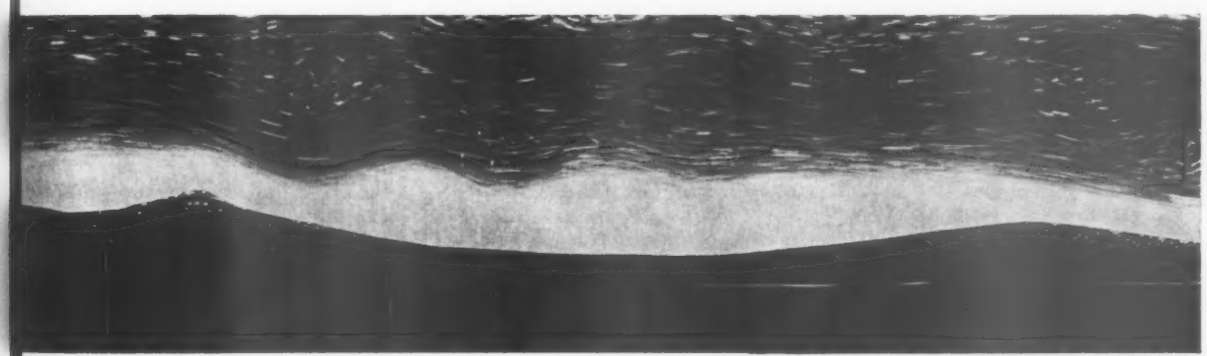
OZARK MOUNTAIN RANGE—ELLIOTT ERWITT, MAGNUM

at least ten per cent faster than it is being replaced; obviously, forestry management must be placed on a sound scientific footing if it is to meet the needs of the future.

One way to learn more is to study past efforts at scientific management of forests—as often for the mistakes they reveal as for their successes. One such experiment, begun in 1908, was the Harvard Forest at Petersham, Massachusetts; this has been the subject of study by John C. Goodlett, associate professor of geography.

In addition to performing experiments, the scientists in charge of the Harvard Forest set out to make it financially self-sufficient. Despite the fact that hardwoods nearly overran the white pine stands, the Harvard managers were determined to keep the stands "pure" and—in accordance with prevailing theory—to cut timber no faster than new pines grew. Many lessons were to be learned from the failures of old formulas and the tentative successes of new approaches.

As a botanist, Dr. Goodlett is primarily concerned with how proper study of environmental conditions might have led to better selection of sites for growing pines. From his investigation may come new and better means for predicting how forests will grow in particular areas.



MODEL OF CURRENTS OVER SIERRA NEVADAS—ROBERT R. LONG

Robert R. Long, professor of fluid mechanics, has succeeded in creating small-scale models which accurately represent air currents over complicated terrain under varying conditions.

The experimental set-up consists of a glass-walled container about twenty feet long, into which has been poured salt water of decreasing concentration towards the surface to represent the varying density of the atmosphere. A solid obstacle is dragged along the bottom of the tank at a controlled speed to simulate the current flowing over it. For a photographic record, aluminum particles are suspended in the water and the camera travels parallel to the obstacles, causing the particles to show up as streaks. (If the exposure time is known, the velocity and direction of the current can easily be calculated from the length of the streaks.)

In the beginning, Dr. Long used simple obstacles to test the physical model against the theoretical, mathematical model. Agreement confirmed, he constructed a facsimile of a section of the Sierra Nevada mountains in eastern California where detailed observations have been made. To test the laboratory model against actual observations, conditions of current speed, temperature, and density variation were matched; the resulting currents over the obstacle proved to be the same as those observed at the site. The difference, of course, is that the laboratory model permits a complete catalog of currents under all possible conditions of temperature, wind speed, and so forth—a feat impossible with direct observation at the site.

A comparison of this catalog with forecast conditions in the Sierra Nevadas would lead directly to a forecast of air currents and of weather in the adjacent valley. "The same approach," Dr. Long points out, "could be used for any locality in the world whose weather is substantially influenced by local terrain."

A Johns Hopkins Gazette

AN UNOFFICIAL COMPENDIUM OF FACULTY AND ALUMNI APPOINTMENTS, HONORS AND ACCOMPLISHMENTS

NEW TRUSTEE

SYDNEY M. CONE, JR., B.A. '25, has been elected an alumni trustee of the University for a six-year term. He was nominated for the trusteeship by the Hopkins alumni association.

Mr. Cone is president of the research and development division of Cone Mills Corporation, a textile firm in Greensboro, N. C., and since 1940 has served as vice-president and director of the Corporation. He is also vice-president and director of Otto B. May, Inc., vice-president and director of Olympic Chemical Company, and a director of Cortley Fabrics Company. For many years, he has been active in professional and community organizations.

THE FACULTY

IN THE FACULTY OF PHILOSOPHY, THEODORE H. BERLIN, professor of physics, has become visiting professor of physics. He has accepted the appointment of professor at the Rockefeller Institute where he is helping to develop a graduate school in theoretical physics.

ELMER V. MCCOLLUM, LL.D. '51 (hon.), professor emeritus of biochemistry, has been awarded the Medal of the New York Academy of Medicine for his contributions to science.

JAMES H. OLIVER, Francis White professor of Greek, has been named a senior fellow of the newly established Center for Hellenic Studies in Washington.

DONALD W. PRITCHARD, professor of oceanography and director of the Chesapeake Bay Institute, has been elected president of the American Geophysical Union.

TAYLOR STARCK, B.A. '11, PH.D. '16 (German), visiting professor of German, has received the honorary degree of doctor of philosophy from the University of the Saar (Saarbrucken).

C. VANN WOODWARD, professor of American history, has resigned to become Sterling professor of history at Yale University.

AT THE SCHOOL OF HYGIENE AND PUBLIC HEALTH, J. HOWARD BEARD, M.D. '50, lecturer in public health administration, has been named president of the Maryland Public Health Association.

ROBERT E. FARBER, M.D. '43, M.P.H. '56, lecturer in epidemiology, has been promoted to the position of assistant commissioner of health for preventive medicine in the Baltimore City Health Department.

ALLAN GOLDFARB, M.P.H. '58, DR.P.H. '59, instructor in public health administration, has become chief of psychological services in the San Mateo (Calif.) Department of Health and Welfare.

AT THE APPLIED PHYSICS LABORATORY, FRANK T. MCCLURE, chairman of the research center, has been awarded the $3000 National Aeronautics and Space Administration Award for his invention of a satellite Doppler navigation system.

ALEXANDER KOSSIAKOFF, assistant director, has been promoted to associate director of the Laboratory.

The following members of the senior staff have been promoted to the principal professional staff: WILLIAM LIBEN, HENRY H. GEORGE, JOHN J. LONG, HILIARY H. NALL, J. BARRY OAKES, RICHARD H. PEERY, ALEC RADCLIFFE, RALPH O. ROBINSON, JR., RONALD E. WALKER, GEORGE C. WEIFFENBACH, AND ALFRED J. ZMUDA.

AMONG THE MEMBERS OF THE BOARDS OF TRUSTEES, DAVID K. E. BRUCE, University trustee, has been appointed ambassador to the Court of St. James.

CHRISTIAN A. HERTER, trustee emeritus, was awarded the honorary degree of doctor of laws at the University's eighty-fifth Commemoration Day ceremonies.

HERBERT J. WATT, Hospital trustee, has been elected president of the Peabody Institute in Baltimore.

AT THE SCHOOL OF MEDICINE, JEROME D. FRANK, professor of psychiatry, has been appointed a member of the advisory committee to the psychiatry and neurology service in the Veterans Administration's department of medicine and surgery.

JAMES L. GAMBLE, JR., assistant professor of pediatrics, has also been appointed assistant professor of physiology.

W. HORSLEY GANTT, associate professor emeritus of psychiatry, has been elected president of the Society of Biological Psychiatry.

GEORGE O. GEY, M.D. '33, associate professor of surgery, has been elected a fellow of the New York Academy of Sciences.

ROBERT W. JOHNSON, JR., M.D. '17, professor emeritus of orthopedic surgery, has received the Physician's Award for his work with the physically handicapped by Governor Tawes of Maryland.

JULIAN WARD REED, assistant professor of medicine, instructor in psychiatry, and director of the Rehabilitation and Medical Care Clinic, has been presented a distinguished community service award by the Baltimore Junior Chamber of Commerce.

OWSEI TEMKIN, William H. Welch professor of the history of medicine and director of the Institute of the History of Medicine, has been awarded the Sarton Medal of the History of Science Society.

HENDRIK VAN DER LOOS has been promoted to assistant professor of anatomy.

GEORGE B. UDVARHELYI, assistant professor of neurological surgery, has also been appointed assistant professor of radiology.

LAWSON WILKINS, professor emeritus of pediatrics, has been honored by his colleagues by the presentation of his portrait to the Harriet Lane Home.

BOOKS

DON CAMERON ALLEN, William Osler professor of English literature: *Image and Meaning: Metaphoric Traditions in Renaissance Poetry* (Johns Hopkins, $4).

SISTER MARY MARGUERITE ANDREW, B.S. '28: *Journal for Mary* (Christopher Publishing House, $4).

HULDAH BANCROFT, hygiene '38–'39: *Introduction to Biostatistics* (Paul B. Hoebler, $5.75).

GORDON E. BIGELOW, M.A. '47, PH.D. '50 (English): *Rhetoric and American Poetry of the Early National Period* (Florida, $2).

EDMUND V. COWDRY, fac. '13–'17 (anatomy), and John C. Finerty: *A Textbook of Histology* (Lea and Febiger).

LAWRENCE DANNEMILLER, G. '55–'58 (Oriental Seminary): *Reading the Word of God* (Helicon, $4.50).

ISRAEL E. DRABLIN, fellow '41–'43 (history of Graeco-Roman science), and Stillman Drake, translators: *Galileo Galilei, "On Motion" and "On Mechanics"* (Wisconsin, $5).

MICHAEL G. HALL, PH.D. '56 (history): *Edward Randolph and the American Colonies, 1676–1703* (North Carolina, $5).

HUGH HAWKINS, PH.D. '54 (history): *Pioneer: A History of the Johns Hopkins University, 1874–1889* (Cornell, $6.50).

L. EMMETT HOLT, JR., M.D. '20, fac. '22–'44 (pediatrics), *et al.: Protein and Amino Acid Requirements in Early Life* (New York, $1)

GRAHAM HOUGH, fac. '50–'51 (English): *Reflections on a Literary Revolution* (Catholic, $2.95).

RAPHAEL LEVY, B.A. '20, M.A. '22, PH.D. '24 (French): *Contribution à la Lexicographie Française selon d'Anciens Textes d'Origine Juive* (Syracuse).

COLLIN S. MACCARTY, M.D. '40, house staff '40–'41 (surgery): *The Surgical Treatment of Intracranial Meningiomas* (Charles C Thomas).

WILLIAM D. MCELROY, professor of bi-

ology and director of the McCollum Pratt Institute: *Cellular Physiology and Biochemistry* (Prentice-Hall; cloth, $2.95; paper $1.50).

HANS J. MORGENTHAU, fac. '58–'60 (SAIS): *The Purpose of American Politics* (Alfred A. Knopf, $5).

LYNN POOLE, director of public relations, and Gray Poole: *Scientists Who Changed the World* (Dodd, Mead; $3).

DONALD F. PROCTOR, B.A. '33, M.D. '37, associate professor of laryngology and otology: *The Tonsils and Adenoids in Childhood* (Charles C Thomas).

RICHARD ROSE, B.A. '53, and David Butler: *The British General Election of 1959* (St. Martin's, $6.75).

RICHARD ROSE, B.A. '53, and Mark Abrams: *Must Labour Lose?* (Penguin).

LOUIS D. RUBIN, JR., M.A. '49 (writing), PH.D. '54 (aesthetics of literature), fac. '49–'54 (writing), and J. R. Moore: *The Idea of An American Novel* (Thomas Y. Crowell).

FRANK G. SLAUGHTER, M.D. '30: *The Land and the Promise* (World Publishing, $3.95).

SATYA SWAROOP, M.P.H. '48, fac. '57–'58 (biostatistics): *Introduction to Health Statistics* (E. and S. Livingstone, Edinburgh).

JOSEPH N. ULMAN, JR., B.A. '28, B.E. '34, and Jay R. Gould: *Technical Reporting* (Henry Holt).

ARCHIBALD F. WARD, JR., education '38–'39: *Seasons of the Soul* (John Knox, $3).

DOROTHY WRINCH, fac. '39–'41 (chemistry): *Chemical Aspects of the Structure of Small Peptides* (Munksgaard, Copenhagen).

Following is the spring list of books published by the Johns Hopkins Press, with approximate publication dates and estimated prices:

JOSEPH ASCHHEIM, assistant professor of political economy: *Techniques of Monetary Control* (April, $4.50).

RUTH BLEIER, G. '57–'58 (German), fellow in psychiatry: *The Hypothalamus of the Cat* (March, $15).

CHARLES H. BOHNER: *John Pendleton Kennedy: Gentleman from Baltimore* (May, $5.50).

GLENN BROOKS, PH.D. '60 (political science): *When Governors Convene: The Governors' Conference and National Politics* (July, $5.50).

RICHARD T. COX, B.A. '20, PH.D. '24 (physics), professor of physics: *The Algebra of Probable Inference* (March, $4.50).

JEROME D. FRANK, professor of psychiatry: *Persuasion and Healing: A Comparative Study of Psychotherapy* (February, $5.50).

JOHN A. GUTHRIE and GEORGE R. ARMSTRONG: *The Western Forest Industry: An Economic Outlook* (April, $6.50).

ARTHUR O. LOVEJOY, LL.D. '51 (hon.), professor emeritus of philosophy: *The Reason, the Understanding, and Time* (May, $3.95).

GEORGE E. OWEN, professor of physics: *The Fundamentals of Scientific Mathematics* (July, $5.50).

FRANCIS E. ROURKE, associate professor of political science: *Secrecy and Publicity: Dilemmas of Democracy* (June, $5).

DEATHS

FRANCIS WHITE, University trustee; on February 23, 1961. Mr. Smith was Assistant Secretary of State under Presidents Coolidge, Hoover, and Roosevelt and was the former ambassador to Mexico and Sweden. Since his retirement from the diplomatic service in 1958, he has been an executive of the Baugh Companies, manufacturers of agricultural chemicals.

THOMAS N. CARVER, G. '91–'93 (history); on March 7, 1961. He was professor emeritus of political economy at Harvard.

ELIZABETH PINKERTON (MRS. JOHN S.) WEBSTER, graduate nurse '96; on December 15, 1960. She was living in Harford County, Maryland.

PHILIP W. HARRY, B.A. '98, PH.D. '03 (Romance languages); on January 11, 1961. He was professor emeritus of Romance languages at Franklin and Marshall College.

JACOB F. YOUNG, B.A. '98, G. '98–'99 (chemistry); on February 7, 1961. He was a director of the Hagerstown (Md.) Trust Company.

WILLIAM R. DANCY, M.D. '00; on September 14, 1960. He was living in Savannah, Ga.

NORMAN EVERETT GILBERT, PH.D. '01 (physics); on March 21, 1961. He was professor emeritus of physics at Dartmouth College.

NANNIE RIDGLEY (MRS. ROBERT) RETZER, graduate nurse '03; on December 22, 1960. She was living in Baltimore.

HARRY KING TOOTLE, B.A. '03; on March 5, 1961. He was the former personnel director of *The New York Times*.

SELMAN GOLDENBERG, arts '04–'05; on December 29, 1960. He was a department store owner in Baltimore.

ISAAC POTTS, arts '04–'07, '10–'11; on December 30, 1960. He was a furniture store owner in Baltimore.

BEVERLY W. BOND, JR., PH.D. '05 (history); on February 1, 1961. He was the retired head of the history department of the University of Cincinnati.

DANIEL ELLISON, B.A. '07, G. '09–'10 (political science); on August 20, 1960. He was a member of the City Council of Baltimore.

HENRY M. MARTIN, PH.D. '07 (Latin); on January 28, 1961. He was professor emeritus of Spanish at Howard College in Birmingham, Ala.

MARY HOOPER (MRS. ROBERT T.) MILLER, graduate nurse '07; on January 20, 1961. She was living in Lake Wales, Fla.

IRVING H. SCHLESINGER, fac. '06–'07 (physiological chemistry); on October 3, 1960. He was professor emeritus of chemistry at the University of Chicago.

JAMES C. MURPHY, G. '09–'11 (political science); on January 6, 1961. He was a retired lawyer.

HARLAN H. YORK, PH.D. '11 (botany); on January 7, 1961. He was a teacher of botany and a forest pathologist in the U.S. Department of Agriculture.

JAMES L. BACCHUS, G. '12–'13 (chemistry), medicine '13–'15; on February 8, 1961. He was an authority on antiques and lived in Chestertown, Md.

JACK VALENTINE THOMAS, arts '12–'13, '14–'15; on June 20, 1960. He was a retired associate professor of industrial engineering at Virginia Polytechnic Institute.

WILLIAM H. BAISH, Hospital staff '13–'61 (dental clinic); on March 21, 1961. He was a dentist in Baltimore.

JEFFERSON H. CLARK, M.D. '15; on January 8, 1961. Before his retirement three years ago, he was chief of laboratories for Philadelphia General Hospital for twenty-seven years.

CHARLES A. WATERS, fac. '15–'46 (roentgenology); on January 9, 1961. Dr. Waters was a prominent radiologist and pioneered in the use of X-ray on certain types of kidney tumors before resorting to surgery.

GERTRUDE C. BUSSEY, G. '16–'17, fellow '20–'23, '25–'28 (philosophy); on March 12, 1961. Dr. Bussey was professor emeritus of philosophy at Goucher College and cofounder of the Maryland Civil Liberties League.

HELEN L. MOUL, MCCOY '17–'26, '41–'42, '51–'52; on December 31, 1960. She was a teacher in Baltimore public schools.

BEVERLEY THURSTON BRANHAM, G. '18–'19 (chemistry); on October 28, 1960. He was a food technologist.

F. HOLMES CATHRALL, M.D. '18, fac. '19–'22, house staff '18–'22 (obstetrics); on February 23, 1961. He was in private practice in Scranton and Dalton, Pa.

FRANCES L. DOLBY, graduate nurse '19; on December 16, 1960. She had been a nurse in Washington, D.C.

HAROLD H. MERCEREAU, B.A. '20; on December 20, 1960. He was living in Hagerstown, Md.

EDWIN S. PANETTI, arts '21–'23; on December 15, 1960. He was a lawyer in Baltimore.

ARTHUR SHAPIRO, B.E. '21; on February 4, 1961. He was a retired patent examiner and lawyer in Washington, D.C.

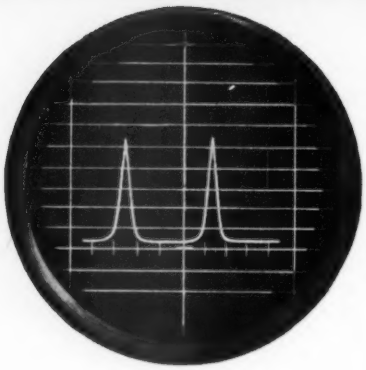
CARL E. W. SCHMEHL, B.S. '22; on December 14, 1960. He was a retired vice principal and teacher of English at Baltimore City College.

SOL J. CORNBLATT, engineering '24–'25; on September 11, 1960. He was an electrical contractor in Baltimore.

ISFRED ISIDOR HOFBAUER, fac. '24–'32 (obstetrics); on March 13, 1961. Dr. Hofbauer had conducted extensive research in the field of endocrinology and was a pioneer in the application of hormones to avoid dangers involved in childbirth.

WILLIAM N. MCFAUL, JR., B.A. '24; on September 21, 1960. He was a surgeon in Baltimore.

HOWARD HUNTER DAVIS, PH.D. '27 (history); on June 25, 1960. He was professor of



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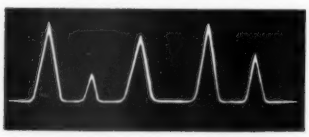

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history at the Richmond division of William and Mary College.

ANNE JANE SIMPSON, G. '27–'29 (political economy); on October 23, 1960. She was a retired psychiatric social worker.

WILLIAM H. M. SMITH, G. '27–'28 (psychology); on December 9, 1960. He was a real estate agent in Annapolis, Md.

WALTER E. DOVE, SC.D. '29 (hygiene); on March 22, 1961. He was a prominent entomologist and parasitologist.

HENRY J. EBERLE, B.S. '29; on January 21, 1961. He was pastor emeritus of Christ Lutheran Church in Baltimore.

HAROLD FINK, M.D. '28, fellow '29–'30, fac. '43–'44, house staff '28–'29 (surgery); on November 24, 1960. He was a retired surgeon and former Duke University Medical Center faculty member.

JOHN VAN ANTWERP MACMURRAY, fac. '30–'35 (Walter Hines Page School); on September 25, 1960. Mr. MacMurray was a career diplomat and served as the first director of the Walter Hines Page School of International Relations.

MARY E. ANDREWS, G. '31–'32 (Oriental Seminary); on November 23, 1960. She was professor emeritus of religion at Goucher College.

RUTH BIXEL KINNEAR, graduate nurse '31; on September 26, 1960. She was living in Brantford, Ontario.

E. BASSE WALLACE, fac. '31–'37 (surgery); on April 28, 1960. He was a physician in Las Vegas, Nev.

JAMES F. BLACKMAN, M.D. '32, house staff '32–'35 (gynecology); on February 8, 1961. He was a physician in Seattle.

ANNE FINNEGAN (MRS. GEORGE G.) GILBERT, graduate nurse '32; on May 23, 1960. She was living in Asheville, N. C.

ROBERT RAINES HARRISS, M.D. '32, house staff '32–'33 (pediatrics); on November 19, 1960. He was a physician in Hollywood, Fla.

J. GAILLARD FREY, B.S. '33; on October 7, 1960. He was president of Frey & Son, Inc., a wholesale grocery firm in Baltimore.

BEVERLEY EUGENE SMITH, fac. '33–'35, house staff '33–'35 (psychiatry); on July 7, 1960. He was living in Jackson, Miss.

WILLIAM RANDOLPH TUCKER, B.A. '33; on December 3, 1960. He was with the Office of Chief Counsel of the U. S. Treasury Department.

W. THOMAS WOODY, fac. '33–'35 (education); on September 11, 1960. He was professor of education at the University of Pennsylvania.

J. JERRY TOULA, B.A. '34; on September 2, 1960. He was an attorney in Baltimore.

LUCRETIA GIBBS, G. '35–'36; on August 26, 1960. She was a teacher in Denton, Md.

JOHN W. POPOW, G. '35–'37 (mathematics); on November 29, 1960. He was associate professor of mathematics at the U. S. Naval Academy.

IDA PAULINE HENDERSON, G. '36–'37 (English); on February 9, 1960. She was living in Emporia, Kansas.

EDGAR J. KEMLER, B.A. '36; on December 1, 1960. He was professor of government at Howard University.

ALMA M. MARTIN, B.S. '36; on January 5, 1961. She was a teacher in the Baltimore public school system.

ALLEN D. RIEMER, M.D. '36; on October 20, 1960. He was assistant clinical professor of medicine at the University of Colorado and practiced internal medicine in Denver.

FRANK VANN CHAPPELL, M.P.H. '37; on November 20, 1960. He was a Hillsborough county (Fla.) health officer.

ALEXANDER KENNEDY, fac. '37–'38 (psychiatry); on November 6, 1960. He was living in Edinburgh, Scotland.

ADOLPH D. COHN, B.S. '38; on February 19, 1961. He was vice-president and secretary of the Sun Life Insurance Company of America.

MELVILLE E. LOCKER, B.S. '38 (economics); on June 9, 1960. He was a lawyer and government official in Washington, D. C.

ERNEST WAKEFIELD PROTHRO, M.P.H. '38; on August 4, 1960. He was living in Austin, Tex.

WALTER GOHRING RYON, M.D. '38; on October 23, 1960. He was in general practice in Schenectady, N. Y.

B. AUBREY SCHNEIDER, SC.D. '39 (hygiene); fac. '39–'41 (biology); on September 22, 1960. He was assistant director of the American Cancer Society's statistical research section.

NELSON E. TAYLOR, JR., arts '39–'40; on November 11, 1960. He was assistant professor of political science and secretary of the faculty at Vassar College.

MAYNARD I. COHEN, M.D. '40; on January 11, 1961. He was in general practice in Silver Spring, Md.

EVELYN MORRIS SMITH, B.S. '40; on August 25, 1960. She was a master in the upper school of Boys Latin School in Baltimore.

CHARLES GOETZ, B.S. '41; on March 3, 1960. He was living in Baltimore.

WILLARD W. GRIGGS, M.P.H. '41; on November 1, 1960. He was a physician in Norwood, N.C.

JOSEPH A. O'NEILL, B.E. '41; on December 27, 1960. He was an electrical engineer and a retired Army major.

RICHARD R. OWENS, fac. '42–'44 (medicine); on November 22, 1960. He was in practice in Muncie, Ind.

JOSEPH TALBOT (IRVING J. TANNEBAUM), B.A. '42; on August 17, 1960. He was living in New York City.

JERRY HIRSH GELLER, G. '45–'46 (chemistry); on January 12, 1961. He was chief chemist at the Veterans Administration Hospital in Pittsburgh.

ROY DONALDSON MCCLURE, JR., M.D. '45; on October 4, 1960. He was a physician in Albuquerque, N. Mex.

WADE H. MILLER, fellow '45–'46 (ophthalmology); on March 13, 1960. He was a physician in Kansas City, Mo.

FRANCIS X. MASKOL, B.S. '47; on September 1, 1960. He was an accountant with the Western Electric Company in Baltimore.

KATHLEEN MOORE, G. '47–'48 (education); on March 14, 1961. She had been an elementary school teacher in Baltimore.

MAHLON F. PECK, G. '48–'50 (physics); on September 12, 1960. He was professor of physics and mathematics at Western Maryland College.

SIDNEY L. CELLER, ED.D. '49; on September 20, 1960. He was an English teacher in Baltimore public schools.

ROBERTSON GRISWOLD, JR., M.A. '50 (English), G. '50–'51 (English); on October 31, 1960. He was head of the English department at the Landon School in Bethesda, Md.

MARTIN J. POLLAK, M.A. '53 (oceanography), fac. '51–'58 (ICR, oceanography); on June 5, 1960. He was senior scientist with the Inter-American Tropical Tuna Commission and research associate at the Scripps Institute of Oceanography.

ROBERT STEWART MCGRAW, M.D. '54; on October 24, 1960. He was a resident physician at the Psychiatric Institute in New York City.

JOSEPH H. FISHER, B.S. IN ENG. '55 (mechanical); on November 18, 1960. He was senior design engineer with the Mutual Chemical Company.

THEODORE SCHWEDENBERG, M.D. '56, fac. '58–'59 (neurology), house staff '56–'57 (medicine); on October 24, 1960. Dr. Schwedenberg was a fellow in neurological medicine.

TONY ADONA, B.A. '58; on December 14, 1960. He was a third-year student at the University of Maryland Law School.

JAY BARRY SELDIN, B.A. '58; on November 23, 1960. He was a graduate student of mathematics at Columbia University.

ABDUL-SAHIB SALIH AL-SAFFER, G. '59–'60 (physics); on November 23, 1960. He was a native of Baghdad, Iraq.

THE ALUMNI

CLARENCE A. SMITH, M.P.H. '39, has become chief of the U. S. Public Health Service's Communicable Disease Center at Atlanta, Ga.

PAUL G. LEFEVRE, B.A. '40, G. '40–'41 (biology), has been appointed professor of pharmacology at the University of Louisville.

THOMAS G. WARD, M.P.H. '40, DR.P.H. '41, fac. '40–'41, '45–'55 (bacteriology, microbiology), has resigned as associate director of the University of Notre Dame's Lobund Institute to become research director at Microbiological Associates in Bethesda, Md.

CHARLES G. WILBER, M.A. '41, PH.D. '42 (zoology), has been appointed dean of the graduate school at Kent State University in Ohio.

HAROLD J. MAGNUSON, M.P.H. '42, fac. '43–'45 (medicine), has been appointed chief of the new division of occupational health of the Public Health Service.

ROBERT L. ZOBEL, M.P.H. '42, has been appointed medical officer in charge of the Indian Health Area officer at Albuquerque.

STUART W. BRUCHEY, B.A. '43, M.A. '46, PH.D. '55 (history), has been promoted to associate professor of history at Michigan State University.

PETER T. KAPSALIS, PH.D. '47 (archaeology), has been named acting professor of Greek at Randolph-Macon College.

DOUGLAS H. K. LEE, fac. '48–'58 (physiological climatology, physiological hygiene, environmental medicine), has been named visiting professor of preventive medicine at Ohio State University.

RICHARD C. MICHAEL, B.E. '48, has become vice-president of the Penn-Mar Foundries in Hanover, Pa.

ALFRED NISONOFF, M.A. '48, PH.D. '51 (chemistry), fellow '51–'52 (medicine), has been appointed associate professor of microbiology at the University of Illinois.

WENDELL B. SELL, M.S. IN ENG. '48, DR. ENG. '50 (electrical), has become vice-president of Marquardt Aircraft Company in Pomona, Calif.

MERVIN SHALOWITZ, B.A. '48, has become assistant clinical professor of medicine at the Stritch School of Medicine of Loyola University.

ALBERT STUNKARD, fac. '48–'52, house staff '48–'52 (psychiatry), has been awarded the Hofheimer Prize by the American Psychiatric Association.

MILTON J. ALLEN, PH.D. '49 (chemistry), has been awarded the distinguished service medal by the University of Liege.

JANE FOX BARLOW, M.A. '49, PH.D. '52, fac. '52–'53 (classics), has been promoted to associate professor of classical languages at Susquehanna University.

STUART L. BROWN, JR., B.E. '49, has been promoted to director of plastics research at Reynolds Metals Company.

PETER A. CASTRUCCIO, G. '49–'50 (physics), and HARRY PRYSTOWSKY, fac. '49–'58, house staff '48–'51, '53–'55 (obstetrics), have been named two of the ten outstanding young men in the country in 1959 by the U. S. Junior Chamber of Commerce.

MARY E. EBERLE, B.S. '49, M.P.H. '56, has been appointed assistant director of administration of the Instructive Visiting Nurse Association of Baltimore.

W. M. LAIR, M.E. '49, DR.ENG. '50 (chemical), has been named director of research and development for the Continental-Diamond Fibre Corporation.

LOUIS D. RUBIN, JR., M. A. '49 (English writing), PH.D. '54 (aesthetics of literature), has been promoted to professor of English at Hollins College.

ROBERT W. BASS, B.A. '50, PH.D. '55 (mathematics), has been named outstanding Maryland scientist of 1960 by the Maryland Academy of Science.

JAMES B. CAMPBELL, M.S. IN ENG. '50 (aeronautical), has been appointed associate professor of physics at the U. S. Military Academy at West Point.

JOHN DEMPSHER, M.D. '50, has become associate professor of pharmacology at Dartmouth College.

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C. DAVID HAACKE, B.E. '50, has been elected president of the Lehigh Chemical Company in Chestertown, Md.

GEORGE B. KOELLE, M.D. '50, fellow '46–'50 (ophthalmology), has been named chairman of the department of pharmacology at the University of Pennsylvania School of Medicine.

GLEN R. LEYMASTER, M.P.H. '50, has been appointed associate secretary in the Council on Medical Education and Hospitals of the American Medical Association.

FRANK S. PARKER, PH.D. '50 (chemistry), has been appointed associate professor of biochemistry at the State University of New York Downstate Medical Center.

BENJAMIN PASAMANICK, fac. '50–'55 (public health administration, psychiatry), has been named Cutter lecturer in preventive medicine for 1960 at Harvard University.

DOROTHY M. SINCLAIR, M.A. '50 (history), has been named coördinator of adult services at the Enoch Pratt Library in Baltimore.

RICHARD H. TURK, III, B.S. '50 (business), has been elected a vice-president of the Pemco Corporation.

DALE C. CAMERON, M.P.H. '51, has become assistant superintendent of St. Elizabeth's Hospital in Washington, D. C.

J. DOUGLAS COLMAN, University and Hospital administration '51–'57, fac. '47–'58 (public health administration), has been elected president of the Associated Hospital Service, Inc. (Blue Cross).

ALBERT J. MEYER, JR., PH.D. '51 (history), has been promoted to associate professor of history at Harvard.

HENRY ALLEN MOE, LL.D. '51 (hon.), has been awarded the honorary degree of doctor of letters by Emory University.

MARY ELLEN PATNO, M.S. '51 (hygiene), has been appointed associate professor of public health statistics at the University of Michigan.

MAURICE C. POWERS, G. '51–'53 (oceanography, geology), fac. '51–'53 (ICR), has been appointed associate professor of geology at Catawba College.

JAMES C. STRONG, M.P.H. '51, has been named health commissioner of Wilmington, Del.

NOLA H. ZAISER, B.S. '51, has been honored by the National Society for the Prevention of Blindness for her work with partially-sighted children.

KONRAD AKERT, fac. '52–'53 (physiology), has been presented the Robert Bing Award in Neurological Sciences by the Swiss Academy of Medical Sciences. Dr. Akert has also been promoted to professor of neuroanatomy at the University of Wisconsin.

CHARLES H. GLATFELTER, PH.D. '52 (history), has been appointed assistant dean of Gettysburg College.

JAMES E. KING, JR., fac. '52–'57 (ORO), '57–'60 (SAIS), has become associate director of research at the Institute for Defense Analyses in Washington, D. C.

CHRISTIAN R. KLIMT, M.P.H. '52, DR. P.H. '59, fac. '59–'60 (hygiene), has been appointed associate professor of epidemiology at the University of Minnesota.

JOHN M. MCKAIN, M.D. '52, house staff '52–'53 (surgery), has been promoted to associate professor and acting chairman of the department of surgery at Creighton University.

AGNES LAWING (MRS. LARRY E.) MILAN, M.D. '52, has been appointed director of medical services for the city of Richmond.

JOHN L. PRATHER, B.A. '52, PH.D. '58 (physics), has been promoted to associate professor of physics at Beloit College in Wisconsin.

RICHARD C. WOOD, G. '52–'56 (English), has been named associate professor of English at Randolph-Macon College.

ARTHUR A. AGETON, M.A. '53 (writing), has been appointed associate professor of creative writing at George Washington University.

VAUGHN C. BEHN, DR.ENG. '53 (sanitary), has been appointed associate professor of civil engineering at Cornell University.

JOSEPH D'ANTONIO, Hospital staff '53–'57, has been appointed chief of medicine at Church Home and Hospital in Baltimore.

MARIE M. DELANEY, SC.M. '53 (hygiene), has been appointed chief of the statistical operations section of the educational statistics branch of the U. S. Department of Health, Education, and Welfare.

REYNOLD C. MERRILL, M.D. '53, house staff '53–'54 (surgery), has become associate director of the Squibb research and development laboratories.

RALPH M. MIWA, PH.D. '53 (political science), has been promoted to associate professor of political science at the University of Missouri.

ROBERT O. MOORE, PH.D. '53 (Romance languages), has been promoted to professor of languages at Wittenberg University.

BEROL L. ROBINSON, PH.D. '53 (physics), has been appointed associate professor of physics at Western Reserve University.

STANLEY A. WERBOW, PH.D. '53 (German), has been awarded a Guggenheim Fellowship to study in Germany.

ALFRED J. BOLLET, fac. '54–'55 (medicine), has been appointed associate professor of internal medicine and preventive medicine at the University of Virginia.

CRAIG L. DOZIER, PH.D. '54 (geography), has been appointed chairman of the department of geography at the Woman's College of the University of North Carolina, Greensboro.

ROBERT F. GLECKNER, PH.D. '54 (English), has received the Emily Hamblen Memorial Award for the best work on William Blake published in 1959 for his book *The Piper and the Bard*.

EDWIN A. HIRSCHMANN, B.A. '54, has been awarded a Fulbright scholarship to study in India.

JAMES A. ENGLISH, PH.D. '55 (biology), has become dean of the school of dentistry at the University of Buffalo.

MILTON A. GOLDBERG, PH.D. '55 (English), has been promoted to associate professor of English at Antioch College.

WILLARD H. GRANT, PH.D. '55 (geology), has been promoted to associate professor of geology at Emory University.

HORACE D. HUMMEL, PH.D. '55 (Oriental Seminary), has become theological professor of the Old Testament at Wartburg Seminary in Dubuque, Iowa.

MARC L. NERLOVE, M.A. '55, PH.D. '56, fac. '58–'59 (political economy), has been named professor of economics at Stanford University.

GEORGE BLUESTONE, PH.D. '56 (aesthetics of literature), has become assistant professor of English at the University of Washington in Seattle.

JAMES D. BRECKENRIDGE, fac. '56–'57, '58–'59 (art), has been appointed associate guest professor of art at the University of Pittsburgh.

EDWARD W. HOOK, JR., fac. '56–'59 (medicine), has become associate professor of medicine and head of the infectious disease division at Cornell University.

JAMES D. KISSENE, PH.D. '56 (English), has been promoted to associate professor of English at Grinnell College in Iowa.

PHILIP R. BECKJORD, DR.P.H. '57, has been promoted to professor of public health practice at Tulane University.

JERZY L. NOWINSKI, fac. '57–'58 (mechanical engineering), has been appointed professor of engineering mechanics at the University of Texas.

LAMBERTO CESARI, fac. '58–'59 (mathematics), has become professor of mathematics at the University of Michigan.

WILLIAM W. CLEVELAND, fellow '58–'60 (pediatrics), has been appointed associate professor of pediatrics at the University of Miami.

EZECHIEL G. COHEN, fac. '58–'59 (physics), has become associate professor of physics at the University of Amsterdam.

FRANCES V. HENRY, hygiene '58–'59, fellow '59–'60 (otology, laryngology), has been appointed director of the hearing and speech clinic at Children's Hospital in Cincinnati.

WILLIAM R. MUELLER, fac. '58–'59 (English), has been appointed associate professor of English at Goucher College.

ROBERT E. MURPHY, PH.D. '58 (psychology), has been appointed chief of the behavioral sciences division of the Air Research and Development Command at Andrews Air Force Base.

ROBERT G. PETERSDORF, fac. '58–'59 (medicine), has become director of medical service at King County Hospital and associate professor of medicine at the University of Washington.

ANTHONY A. PREUS, G. '58–'59 (philosophy), is at Oxford University as a Rhodes Scholar.

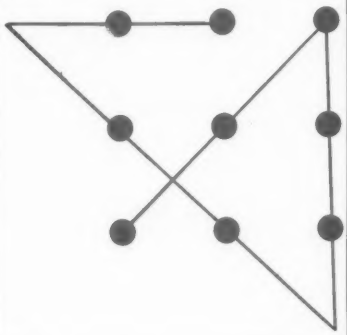
BRADLEY R. STRAATSMA, fellow '58–'59 (ophthalmology), has been appointed associate professor and chief of ophthalmology at the University of California.

VIRGINIA APGAR, M.P.H. '59, has received the Elizabeth Blackwell Award for her contributions to medicine.

JAMES F. GOVAN, PH.D. '60 (history), has been appointed head librarian at Trinity University in San Antonio, Tex.

DALE E. HARRO, M.P.H. '60, fac. '59–'60 (pediatrics), has become director of school hygiene for Baltimore.

ANSWER TO PUZZLE ON COVER IV OF LAST MONTH'S ISSUE



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ABOUT THE AUTHORS

HARRISON S. BROWN is professor of geochemistry at the California Institute of Technology. Since receiving his PH.D. from Johns Hopkins in 1941, he has been director of chemistry at the Clinton Laboratories in Oak Ridge, Tenn., research associate at the University of Chicago, and a member of the faculty of the Institute for Nuclear Studies. He is a member of the National Academy of Sciences, and in 1947 won the annual award of the American Association for the Advancement of Science. In 1952 he was presented the pure chemistry award from the American Chemical Society. His publications include *Must Destruction Be Our Destiny?*, *The Challenge of Man's Future*, and *The Next Hundred Years*.

RACHEL CARSON is author of *Under the Sea-Wind*, *The Edge of the Sea*, and the 1951 National Book Award winner *The Sea Around Us*. She began her study of biology at Pennsylvania College for Women and received her M.A. in zoology from Johns Hopkins in 1932. She has taught at the University of Maryland and Johns Hopkins and has done research at the Marine Biological Laboratory at Woods Hole, Mass. Until 1952, she was a marine biologist and editor-in-chief of the U.S. Fish and Wildlife Service. In 1951 she was awarded a Guggenheim Fellowship to further her study of the seashore. She is a member of the National Institute of Arts and Letters and the Royal Society of Literature.

GEORGE F. CARTER, professor of geography at Johns Hopkins, is an authority on the antiquity of man in America. Before joining the Hopkins faculty in 1943, Dr. Carter was curator of anthropology at the San Diego Museum of Man. He earned his PH.D. at the University of California and in 1953 was awarded a Guggenheim Fellowship. Dr. Carter is author of *Plant Geography and Culture History in the American Southwest* and *Pleistocene Man at San Diego*.

WILLIAM D. MCELROY, professor and chairman of the department of biology and director of the McCollum Pratt Institute, is a trustee of Associated Universities, Inc., and the Marine Biological Laboratory at Woods Hole, Mass., a member of the advisory board of the National Science Foundation, and chairman of the biochemical study section of the National Institutes of Health. He is author of *Cell Physiology and Biochemistry*.

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News from Johns Hopkins

A CONCISE REVIEW OF INTERESTING AND SIGNIFICANT EVENTS AND DEVELOPMENTS AT JOHNS HOPKINS

● Although the various programs which provide continuing education to physicians after they have received their medical degrees have grown to such an extent that post-doctoral students at the School of Medicine now outnumber medical students by 424 to 336, no formal curriculum has as yet been established in the post-doctoral area. The programs have consisted largely of research work and clinical application of patient treatment techniques.

Recognizing this deficit, the Commonwealth Fund has presented the University a grant of $235,000 to develop a coördinated program of post-doctoral medical education.

The man charged with the responsibility of directing and developing the School's post-doctoral programs is Gilbert H. Mudge, professor and chairman of the department of pharmacology and experimental therapeutics and recently appointed associate dean of the School.

● *The Sculptural Programs of Chartres Cathedral* by Adolf Katzenellenbogen, professor of the history of art, and published by the Johns Hopkins Press, has been awarded the Morey Prize of the College Art Association of America as "the best book in the field of scholarship in the history of art for 1959."

● A new graduate curriculum which integrates the engineering and medical sciences will be initiated at Johns Hopkins next fall.

The new program in "biomedical engineering" leading to the doctoral degree is the first of its kind in the country to train students in advanced engineering subjects of particular pertinence to research in biological systems and to offer systematic study in how the principles of physical and engineering science apply to biological systems.

Through a collaboration between the School of Engineering and the School of Medicine, William B. Kouwenhoven, professor emeritus of electrical engineering, was able to conduct his research on the effect of electrical currents on the anatomy which led to his pioneering use of electric shock as a means of overcoming heart fibrillation and his subsequent development of closed chest cardiac massage.

Two other institutions, the University of Pennsylvania and the University of Rochester, are coöperating with Johns Hopkins in instituting similar programs. The three universities will engage in an exchange program whereby students and faculty members may teach and study at all three schools. The information center and basic library collections necessary for the new program will be located at Johns Hopkins.

● Each year since 1958 the American Council of Learned Societies, a federation of thirty national scholarly organizations, has awarded $10,000 prizes to the ten professors in the country they consider to have contributed the most to humanistic scholarship.

One of the ten recipients of the award this year was William F. Albright, professor emeritus of Semitic languages. Dr. Albright has gained an international reputation through his reconstruction of ancient civilization by examination of artifacts and deciphering of dead languages. He has directed several archaeological expeditions to the Near East and is one of the world's foremost authorities on the Dead Sea scrolls.

Dr. Albright is the second Hopkins scholar to receive the award. In 1958 the Council recognized the distinguished accomplishments of Arthur O. Lovejoy, professor emeritus of philosophy.

● During the 1959–60 academic year, 41 per cent of the University's undergraduates received scholarship aid, Robert L. Strider, director of financial aid, has reported.

In releasing the report on the financial aid program at Johns Hopkins, Mr. Strider pointed out that the average scholarship grant during 1959–60 was $777 (applied against a tuition cost of $1200). He also noted that next year, when the University's tuition rate is increased to $1450, additional scholarship funds will be needed to attract the same caliber of student to Johns Hopkins.

"The scholarship grant," Mr. Strider said, "is not simply an award to help a deserving student. It is an active tool to be used by the University in attracting the best possible student body. Without scholarship support, we could not attract many students of excellent academic standing of modest means."

● The Johns Hopkins Press has been awarded a $10,400 grant from the Ford Foundation to stimulate the publication of scholarly works in the humanities and social studies.

The award is the fifth such grant given to the Press in the past five years as part of a program begun in 1956 to aid young scholars in publishing.

● Four Pulitzer Prize winners will be among the nine American poets who will participate in a five-day poetry festival at Johns Hopkins in October.

It will be the second such program of lectures and poetry readings held at the University. The first, in 1958, was attended by more than 10,000 persons.

The poets in this year's program will include Richard Eberhart, John Holmes, May Sarton, Randall Jarrell, Josephine Jacobsen, Robert Lowell, Theodore Roethke, Peter Viereck, and Richard Wilbur.

The program is being presented with the aid of the Bollingen Foundation. The lectures will be a part of the Percy Graeme Turnbull Memorial Lectures which have been given every two years since 1880.

● The first step in the plan to enlarge the facilities of Levering Hall and the cafeteria will be the construction of a new wing, consisting of a ground and second floor, to the south of the existing cafeteria area. The addition will cost $225,000.

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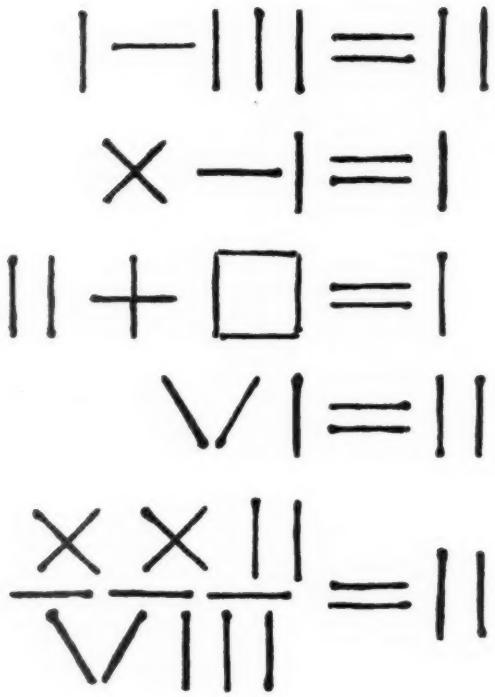

At left are five incorrect equations made with matchsticks. Change each into a true equation by altering the position of only one matchstick. (In the third puzzle, the square is intended to represent zero.) The answer to last month's puzzle can be found on page 47.

The Equation . . .

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